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# Warfare on the Deccan Plateau, 1450–1600: A Military Revolution in Early Modern India?*

RICHARD M. EATON AND PHILIP B. WAGONER

> I also send your highness a Goan master gunsmith; they make guns as good as the Bohemians and also equipped with screwed in breech plugs. There he will work for you. I am sending you some samples of their work with Pero Masquarenhas.
>
> —Afonso de Albuquerque, viceroy of the *Estado da India*, writing from Goa to King Manuel I of Portugal (1513)[1]

> Aflatun Khan laid the foundation of a very strong fortification in this fort. In it, he constructed a stone bastion, the like of which had not been seen by the eyes of the world. It was higher than the heavenly sphere; hence its date has come to be "the heavenly sphere." O Kind One! Year 974 [1566–1567 C.E.]. O Opener! Its composer and writer is Hushi Shirazi.
>
> —Galna inscription of Aflatun Khan, 1566–1567[2]

One of the payoffs of studying world history is the opportunity it affords to evaluate historical hypotheses generated from data in one part of the world, with a view to testing them against comparable

* Material in this essay has been derived from Richard M. Eaton and Phillip B. Wagoner, *Power, Memory, Architecture: Contested Sites on India's Deccan Plateau, 1300–1600* (New Delhi: Oxford University Press, 2014).

[1] Rainer Daehnhardt, *The Bewitched Gun: The Introduction of the Firearm in the Far East by the Portuguese* (Lisbon: Texto Editora, 1994), p. 39.

[2] *Epigraphia Indica—Arabic and Persian Supplement* (1967), p. 45, pl. XI(b).

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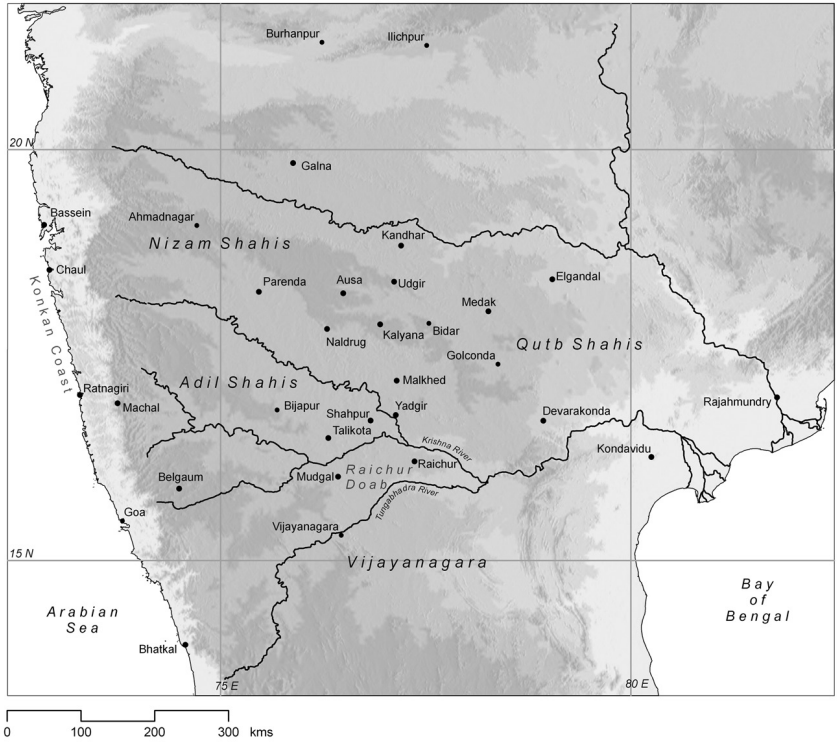
data from another part of the world. For the past four decades, the notion of an early modern "Military Revolution" has been debated among Europeanists; more recently it has been discussed among students of world history.[3] This raises the question of how successfully a theory derived from Euro-American data can be validly extended across the planet. As a general principle, India—well known for its recalcitrant complexities—has proven to be a graveyard, or at least a stumbling block, for many a high theory derived from Euro-American data. The question, then, is whether the Military Revolution, if it is to be understood as a global phenomenon, can fare any better.

According to conventional understandings of the Military Revolution, the introduction of firearms in early modern European warfare yielded wide-ranging consequences that were by no means confined to the realm of military affairs. The present essay examines the earliest known introduction of firearms technology in India, with a view to evaluating how its consequences there compared or contrasted with those claimed to have occurred in early modern Europe. We further ask: Why did cannon appear in the dry, upland plateau of peninsular India, known as the Deccan, before anywhere else in India? Within the Deccan, how can we explain the different responses to the advent of gunpowder technologies? What effects did new military technologies have on the Deccan's architectural landscape, and on its society at large?

## The Raichur Doab as a Contested Zone, 1347–1520

The best answers to these questions are found in the Raichur Doab, the fertile tract of land lying between and on either side of the Krishna and Tungabhadra rivers, which run west to east through the heart of

[3] A good entrée into the voluminous literature on the Military Revolution debate is Clifford J. Rogers, ed., *The Military Revolution Debate: Readings on the Military Transformation of Early Modern Europe* (Boulder, Colo.: Westview, 1995). See also David Eltis, *The Military Revolution in Sixteenth-Century Europe* (London: Tauris Academic Studies, 1995); Andrew Ayton and J. L. Price., *The Medieval Military Revolution: State, Society and Military Change in Medieval and Early Modern Europe* (London: Tauris Academic Studies, 1995); Bert S. Hall, *Weapons and Warfare in Renaissance Europe: Gunpowder, Technology, and Tactics* (Baltimore: Johns Hopkins University Press, 1997), pp. 201–235; Jeremy Black, *War and the World: Military Power and the Fate of Continents, 1450–2000* (New Haven, Conn.: Yale University Press, 1998); Kelly DeVries and Robert D. Smith, *Medieval Weapons: An Illustrated History of Their Impact* (Santa Barbara, Calif.: ABC-CLIO, 2007); and Frank Tallett and D. J. B. Trim, eds., *European Warfare, 1350–1750* (Cambridge: Cambridge University Press, 2010).




Map 1. The Deccan plateau, sixteenth century.

the Deccan plateau (Map 1). In the early fourteenth century, following invasions by armies of the Delhi sultanate, the sultan of Delhi subcontracted governance of much of the central and southern Deccan to local client-chiefs, whom he integrated into his imperial service as *amir*s ("commanders"). The Raichur Doab appears to have been among the regions assigned to one such chief, Harihara Sangama.[4] But by 1339 Harihara had asserted his independence from his north Indian

[4] Ibn Battuta, *The Rehla of Ibn Battuta*, trans. Mahdi Husain (Baroda: Oriental Institute, 1953), p. 96; Zia al-Din Barani, *Tarikh-i Firuz Shahi*, in *The History of India as Told by Its Own Historians*, ed. and trans. H. M. Elliot and John Dowson (Allahabad: Kitab Mahal, 1964), 3:245; 'Abd al-Malik 'Isami, *Futuhu's Salatin*, ed. and trans. Agha Mahdi Husain (Bombay: Asia Publishing House, 1967), 3:902.

overlords,[5] and when Delhi then lost all of its Deccan possessions to rebellious forces in 1347, he and his brothers carved out a new state centered on a local pilgrimage site on the southern banks of the Tungabhadra River on the southern edge of the Raichur Doab. Thus was born the city and kingdom of Vijayanagara (1347–1565).

Meanwhile, the plateau to the north of Vijayanagara fell to another group of anti-Delhi rebels, many of them descendants of north Indian migrants to the Deccan. This group established the Bahmani sultanate (1347–1518), and for the next century and a half Bahmani sultans and the kings of Vijayanagara repeatedly fought over control of the rich Raichur Doab that lay between them. For most of this time the Bahmanis dominated the region, most importantly the city and fort of Raichur. There, in 1468–1469 they built an elaborate system of bastions and curtain walls surrounding the fort that incorporated state-of-the-art military engineering from the contemporary Middle East: battered walls built of rubble and mortar masonry encased within a protective layer of tightly fitted ashlar, and projecting bastions equipped with counterweight trebuchets. As will be discussed below, they also placed gun ports in their curtain walls in order to accommodate the latest weapon: cannon.

Around the turn of the sixteenth century there appeared three new players whose actions would govern subsequent struggles over the Raichur Doab. First, in 1490, amid the Bahmani kingdom's growing internal decay, the governor of that kingdom's important provincial town of Bijapur, Yusuf 'Adil Khan, declared his independence, at the same time claiming the Raichur Doab as part of his domain. He would become known as the founder of the 'Adil Shahi sultanate of Bijapur (1490–1686). Second, from 1498 the Portuguese Estado da India, determined to monopolize control over Arabian Sea commerce, emerged as a powerful naval and land power in western India. Its commercial and political influence would soon extend from several coastal enclaves to the Deccan's interior. And third, in 1505 there appeared in Vijayanagara a vigorous new dynasty of kings under whom the balance of power in the Doab would tilt toward the south for the first time in a century

[5] In 1339 Harihara was ruling independently over widely dispersed regions and had adopted the grandiose title "Lord of the Oceans of East and West" (Vasundhara Filliozat, *l'Épipgraphie de Vijayanagara du début à 1377* [Paris: École Francaise de l'Extrême-Orient, 1973], pp. 2–4). In 1342 Ibn Battuta identified him as the sovereign over the Muslim ruler of the port of Honavar in northern Malabar, without mentioning any connection he might have had with the Delhi sultanate (Ibn Battuta, *The Rehla of Ibn Battuta,* trans. Mahdi Husain [Baroda: Oriental Institute, 1953], p. 118).

and a half. In 1509 the throne passed to the renowned Krishna Raya (r. 1509–1529), whose twenty years of rule are widely acclaimed as the acme of Vijayanagara's power and glory. As heir to Vijayanagara's long-standing quest to possess the Raichur Doab, Krishna Raya would find support for his cause in the Portuguese, whose general hostility toward Muslim states like Bijapur had been shaped by the previous century's anti-Muslim *reconquista* movement in Spain and Portugal. Thus, in 1510 the Estado's viceroy and master strategist from 1509 to 1515, Afonso de Albuquerque, assisted by a coastal warlord loyal to Vijayanagara, seized the port of Goa from Yusuf 'Adil Khan's fledgling kingdom of Bijapur. The Raichur Doab now became the object of a three-cornered struggle involving Bijapur, Vijayanagara, and, supporting the latter from their base in Goa, the Portuguese Estado da India.

## Gunpowder Technology in the Deccan, 1450–1520

Apart from the considerable political influence that the Portuguese brought to the Deccan, they also introduced new forms of gunpowder technology to the region. The extent of their influence in this regard, however, is hotly debated. Much depends on how one evaluates the state of India's firearm technology prior to the Europeans' arrival. In an important monograph, Iqtidar Alam Khan has argued that in the second half of the fifteenth century Indians were using cannons cast in brass or bronze, as well as handguns.[6] But the matter is complicated. The nomenclature of weapons changed over time, few Indian sources are contemporary with the battles they describe, and later sources often used words anachronistically, projecting terms of their own day backward to earlier periods. In view of such considerations, Jos Gommans has questioned Iqtidar Alam Khan's assertions respecting a fifteenth-century horizon for the earliest appearance of firearms in India.[7]

Notwithstanding Gommans's reservations, there is considerable evidence, both literary and archaeological, that firearms were indeed being used in peninsular India prior to the rise of Portuguese power in the region. The most conclusive archaeological evidence of this is the gun ports that Bahmani rulers built into the walls at three of

[6] Iqtidar Alam Khan, *Gunpowder and Firearms: Warfare in Medieval India* (Delhi: Oxford University Press, 2004), pp. 42–44.

[7] Jos Gommans, *Mughal Warfare: Indian Frontiers and High Roads to Empire, 1500–1700* (New York: Routledge, 2002), p. 146, and n. 52.

their principal forts: Bidar, Kalyana, and Raichur. They were circular or arched at Bidar and Kalyana, and square at Raichur[8] (Fig. 1). At Kalyana the construction of walls bearing such ports appears to date to 1461–1463,[9] those of Raichur to 1468–1470,[10] and those of Bidar to the reign of Muhammad III (1463–1482).[11] These nearly simultaneous construction activities thus point to the 1460s as the earliest horizon for the use of cannon in the Deccan—indeed, in India. Literary evidence for the advent of gunpowder technology in the region appears at about the same time. The famous Bahmani *vazir* Mahmud Gawan (fl. 1453–1481) wrote that in January 1471 troops under his command besieged and demolished the fort of Machal (in the Sahyadri range inland from the Arabian Sea port of Ratnagiri) by deploying "roaring thunder [*r'ad*], which having the effect of a thunderbolt, showered [on the fort] like rain"—a passage that suggests the use of siege cannon.[12] This report would seem to support a statement of the Persian chronicler Firishta that in the very next year, Bahmani forces used cannon (*tup* and *zarbuzan*) during their siege of Belgaum, an ally of Vijayanagara.[13] Firishta adds that on that occasion engineers under Gawan's

[8] As these gun ports are too large for muskets and too close to the floor level of the battlement to facilitate shooting arrows, they could only have been built to accommodate cannon. At Raichur the square gun ports were positioned at the pavement of the battlement, while loopholes were placed at a higher elevation that would enable firing by either bows or matchlock firearms.

[9] The period of the construction of Kalyana's walls is mentioned in Abd al-Qadir Badayuni, *Muntakhab al-tawarikh* (Calcutta, 1867), 3:452, cited in Sherwani, *The Bahmanis of the Deccan* (New Delhi: Munshiram Manoharlal, 1985), p. 189.

[10] The dating of Raichur's walls is inferred from the dates of the construction of the two gates that pierced them, the Kamani gate and the Mecca gate, built in 1468–1469 and 1469–1470, respectively (A. A. Kadiri, "Bahmani Inscriptions from Raichur District," *Epigraphia Indica, Arabic and Persian Supplement* [1962], pp. 58–60). Crucially, the areas on the western wall where the square gun ports are found appear to be completely continuous with the rest of the masonry and with the gate itself, which is dated 1469–1470.

[11] The Persian chronicler Firishta (fl. 1591–1623) writes that Sultan Muhammad III (r. 1463–1482), while campaigning in the eastern Deccan, ordered Mahmud Gawan to repair an old fort originally built during the Tughluq occupation, and that while doing so, Gawan equipped the fort with cannon (*tup*) and light cannon (*zarbuzan*) (Firishta, *Tarikh-i Firishta*, 1:355). G. Yazdani reasons that if the sultan were willing to equip even minor forts with cannon, he would surely have done the same with his capital. See G. Yazdani, *Bidar, Its History and Monuments* (London: Oxford University Press, 1947), p. 29.

[12] "Ra'd-i chakachak sa'iqa tasir chinan baran gardanid," Mahmud Gawan, *Riaz al-insha'* (Hyderabad: Government Press, 1948), p. 72. Iqtidar Alam Khan has argued that the terms *r'ad* or *kaman-i r'ad* were the generic terms used in contemporary Persian texts for the primitive firearms in vogue in India, Central Asia, and Iran during the fifteenth century (Iqtidar Alam Khan, *Gunpowder and Firearms: Warfare in Medieval India* [New Delhi: Oxford University Press, 2004], p. 10).

[13] Firishta, *Tarikh-i Firishta* (Lucknow: Nawal Kishor, 1864–1865), 1:352.

FIGURE 1. Bidar fort. Citadel wall and two-storied polygonal bastion, ca. 1463–1482. Each face of the bastion has an arched port for cannon at floor level, flanked by smaller loopholes for bows or matchlocks at shoulder level.

command called *atish-bazan* ("fire-workers") deployed explosive mines that peoples of the Deccan had never seen before.[14]

European sources dating to the period shortly after the advent of the Portuguese also refer to the use of firearms among local powers in the region. Gaspar Correia, Albuquerque's secretary and an early chronicler of the Estado da India, records that in 1502 Portuguese naval squadrons were bombarded from the hilltop overlooking the port of Bhatkal.[15] Several years later the Italian traveler Ludovico di Varthema recorded seeing artillery at the port of Chaul, then controlled by

[14] "Bi sakhtan-i sarkub va naqb ki ta an zaman dar Dakan sha'i' nabud," Muhammad Qasim Firishta, *Tarikh-i Firishta* (Lucknow: Nawal Kishor, 1864–1865), 1:352; John Briggs, trans., *History of the Rise of the Mahomedan Power in India* (1829; repr. Calcutta: Editions Indian, 1966), 2:303.

[15] Gaspar Correia, *Lendas da India* (Lisbon: Typ. da Academia Real das Sciencias, 1860), 1:289–290; cited in Sanjay Subrahmanyam, *The Political Economy of Commerce: Southern India, 1500–1650* (New York: Cambridge University Press, 1990), p. 124.

Bijapur's neighbor, the sultanate of Ahmadnagar.[16] Albuquerque's own son recalled that when his father took Goa in 1510, Bijapuri defenders greeted the invaders with artillery fire.[17] Later that same year, after first losing and then recapturing the city, Albuquerque seized from Bijapur's defenders a hundred large guns (*bombardas*) and a "large quantity" of smaller artillery.[18]

The presence of cannon technology in the Deccan prior to European maritime contact, then, seems beyond dispute. More challenging is reconstructing the vectors by which such technology reached the Deccan in the late fifteenth and early sixteenth centuries. It is theoretically possible that the ordnance used at Bhatkal in 1502, or seen at Chaul several years later, had been captured from the Portuguese in some naval engagement and then subsequently turned against the same Europeans. But this is unlikely, given the very short time that had elapsed since Vasco da Gama's 1498 voyage to Calicut—the dawn of Portuguese presence in the Indian Ocean—and especially given the Bahmanis' known offensive and defensive use of cannon in the Deccan interior since the 1460s. In our view, the most likely source of this technology was the Mamluk sultans of Egypt, who possessed both cannon technology and a vested interest in the lucrative spice trade from India to Europe during the latter half of the fifteenth century.[19] We also know that the Bahmani *vazir* Mahmud Gawan, the same figure who wrote of besieging the fort of Machal in 1471 with "roaring thunder [*r'ad*]," maintained close commercial and diplomatic relations with both Mamluk Egypt and the Ottomans.[20] Having captured the strategic

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[16] John Winter Jones, trans. *The Travels of Ludovico di Varthema* (1863; repr. New York: Burt Franklin, n.d.), p. 114.

[17] Afonso de Albuquerque, *The Commentaries of the Great Afonso Dalboquerque, Second Viceroy of India*, trans. Walter de Gray Birch (1875–1884; repr. New York: B. Franklin, 1970), 2:89.

[18] Ibid., 3:16.

[19] An inscribed powder chamber from a wrought iron cannon made in the reign of Sultan Qayit Bay (r. 1468–1496) is preserved in the Military Museum in Istanbul. We also know that the Ottoman sultan Bayazid II (r. 1481–1512) lent the Mamluks artillery and copper for casting cannon for the latter's Indian Ocean fleet (Giancarlo Casale, *The Ottoman Age of Exploration* [Oxford: Oxford University Press, 2010], p. 32, n. 79).

[20] In a published collection of Gawan's correspondence, letter 134 is addressed to the Mamluk sultan, and letters 5, 56, 143, and 144 are addressed to Ottoman sultans. See Mahmud Gawan, *Riyaz al-insha'*, ed. Ghulam Yazdani (Hyderabad: Dar al-Tab', 1948). Thanks to Gawan's exertions, the Bahmanis were the only Indian state to exchange ambassadors with the Ottoman court. In 1481, a Bahmani deputation bearing elephants, giraffes, spices, ornaments, and other precious gifts was sent to congratulate Bayazid (r. 1481–1512) on his accession to the Ottoman throne (Shai Har-El, *Struggle for Domination in the Middle East: The Ottoman-Mamluk War, 1485–1491* [Leiden: Brill, 1995], pp. 113, 130).

seaport of Goa (then a protectorate of Vijayanagara) in 1472,[21] Gawan for the next ten years sent Bahmani agents through Mamluk Egypt to Bursa, in western Anatolia, and from there into the Ottoman Balkans to market Indian textiles.[22]

It is thus very likely that the Mamluks furnished the Bahmanis with ordnance in exchange for textiles, spices, and other commodities destined for Western markets. The best material evidence for this inference is the wrought iron tube cannons that still lie on the ramparts of former Bahmani forts at Bidar, Medak, Yadgir, and Devarakonda (Fig. 2). Made in two parts with separable barrels and powder

Figure 2. Bidar fort. Barrel of a tube gun (cannon no. 3) lying on the Kalmadgi Burj, ca. 1500–1520. The gun is of forge-welded wrought iron construction, and the staves, bands, and hoops are clearly visible at the muzzle end (foreground). The barrel is open at the breech end to accommodate the separate powder chamber (not preserved for this gun).

[21] Sherwani, *Bahmanis*, pp. 218–219.

[22] See Halil Inalcik, "Bursa and the Commerce of the Levant," *Journal of the Economic and Social History of the Orient* 3 (1960): 141.

chambers, these early cannons appear typologically identical to those that the Ottomans reportedly captured from the Mamluks in the late fifteenth or early sixteenth century, which are preserved in Istanbul's Military Museum.[23] Inasmuch as walls with gun ports were being built in at least three major Bahmani forts in or soon after the 1460s, as noted above, we may infer that the tube cannons presently standing on the four above-mentioned forts were either introduced to the Deccan from across the Arabian Sea or, still more likely, produced in the Deccan from Mamluk prototypes.

A second vector of technology transfer came somewhat later via the Portuguese, some of whose own weapons appear to have been quickly assimilated into an ongoing indigenous tradition of firearms manufacture in the western Deccan. When they conquered Goa in 1510, the Portuguese found that the Bijapuris had already established a formidable munitions plant in that city. According to an important document transcribed by Gaspar Correia, at the time of the Portuguese conquest there were in Goa

> large houses with storage space which the Turks [*os rumes*] had filled with all the materials necessary for shipbuilding, and lots of iron and mortar artillery, large and small, and also two of our camel cannons and eight cradles [*berços*] and mortars which the Turks had brought

[23] Photographs of tube cannons that the Ottomans are said to have captured from Mamluk forces appear in David Nicolle, *Historical Atlas of the Islamic World* (New York: Checkmark Books, 2003), p. 133. We thank Mark Wyers for measuring the two Mamluk guns preserved in Istanbul's Military Museum. The following table compares the dimensions of these two guns with six wrought iron tube guns discovered at Deccani forts. The notation for the pattern of hoops follows the system proposed by Robert D. Smith, according to which 1 refers to the band; 2 refers to the hoop over the band, and 3 refers to a hoop of greater diameter than a 2 hoop. See R. D. Smith, "Towards a New Typology for Wrought Iron Ordnance," *International Journal of Nautical Archaeology and Underwater Exploration* 17 (1988): 11.

| Gun | Length of barrel (cm) | Bore (cm) | Pattern of hoops |
|---|---|---|---|
| Mamluk no. 1 (Istanbul) | 172.5 | 18 | 9 hoops in 1-2 pattern |
| Mamluk no. 2 (Istanbul) | 152.5 | 17.5 | 8 hoops in 1-2 pattern |
| Bidar no. 3 | 426 | 17 | 6 sets in 1-2-3-2 pattern |
| Medak no. 2 | 328 | 15 | 3 sets in 1-2 pattern |
| Yadgir no. 1 | ? [gun mostly buried] | ? | 3 sets (visible) in 1-2 pattern |
| Medak no. 1 | 227 | 16 | 2 sets of lug hoops in 1-2-3 pattern |
| Devarakonda no. 1 | 210 | 23.5 | 3 sets of lug hoops in 1-2-3 pattern |
| Bidar no. 9 | 265 | 35 | no hoops |

> from the defeat of Dom Lourenco at Chaul [in January 1508], and other metal pieces in their fashion and a great number of metal guns, and a large quantity of gunpowder, saltpetre and utensils used in the making of these, and an enormous quantity of all kinds of weapons.[24]

Correia's reference to "our" camel cannons, cradles, and mortars clearly points to a second, European vector of technology transfer to India. In the Battle of Chaul of 1508, mentioned in the passage above, a group of warships belonging to Mamluk Egypt and the sultan of Gujarat had engaged and defeated a Portuguese naval squadron off the Konkan coast. This was the first military reversal the Portuguese had suffered in the Indian Ocean since their arrival there a decade earlier.[25] As the extract relates, one consequence of this engagement was that Turks ("Rumis"), who were evidently mercenaries in the victorious coalition, captured firearms from the Portuguese and took them to Goa, where they were integrated into the existing stock of that city's arsenal.[26] Further information on this pattern of technology transfer is furnished by the historian Duarte Barbosa, who was in India from about 1500 to about 1516. He writes that the same participants that fought off Chaul in 1508 engaged in a second maritime battle the following year off the Gujarat coast near Diu. In this engagement, which the Portuguese won, a group of Turks escaped to Goa and were promptly received and employed by Bijapuri authorities in the Goa arsenal. Local Muslim merchants, continues Barbosa, helped resettle these men in Goa; they also financed the building of shipyards and plants for the manufacture of both iron and bronze ordnance.[27]

Following the two naval engagements of 1508 and 1509, then,

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[24] Gaspar Correia, *Lendas da India* (Lisbon: Typ. da Academia Real das Sciencias, 1860), 2:60. Translated in Rainer Daehnhardt, *The Bewitched Gun: The Introduction of the Firearm in the Far East by the Portuguese* (Lisbon: Texto Editora, 1994), p. 37.

[25] This conflict had been precipitated by Mamluk and Ottoman concerns over the Portuguese disruption of trade in the region. See Giancarlo Casale, *The Ottoman Age of Exploration* (New York: Oxford University Press, 2010), pp. 25–29; Palmira Brummett, *Ottoman Seapower and Levantine Diplomacy in the Age of Discovery* (Albany, N.Y.: SUNY Press, 1994), pp. 111–115; M. Longworth Dames, "The Portuguese and Turks in the Indian Ocean in the Sixteenth Century," *Journal of the Royal Asiatic Society* (1921): 1–11; E. Denison Ross, "The Portuguese in India and Arabia between 1507 and 1517," *Journal of the Royal Asiatic Society* (1921): 547.

[26] As Casale notes, most Portuguese sources of this period "use the notoriously vague terms 'Turk' and 'Rumi' with reference to both Ottomans and Mamluks" (Casale, *Ottoman Age*, p. 213, n. 77).

[27] Mansel L. Dames, trans., *The Book of Duarte Barbosa* (1918; repr. Nendeln/Liechtenstein: Kraus Reprint, 1967), 1:175–177.

guns captured from the Portuguese found their way to Goa, followed by Mamluk or Ottoman gunners and gunsmiths.[28] Numerous Venetian and Genoese renegades also inhabited Goa at the time of the Portuguese conquest of 1510, and these, too, were likely employed in the arsenal.[29] All of these influences considerably enriched and expanded Goa's existing firearms industry. Building on these several vectors of technology transfer—the Mamluk, the European, and the Ottoman—gunsmiths of Goa working under Bijapuri authority seem to have made very high-quality firearms, both cannon and matchlocks. Indeed, after taking possession of the city in 1510, the Portuguese viceroy, Albuquerque, was so impressed with the gun-making skills he encountered in Goa that he sent to the king of Portugal samples of the heavy cannon made by local Muslims.[30] Nor was the high quality of locally manufactured firearms confined to cannon making. In early December 1513, the viceroy reported that matchlocks made by Goa's master gunsmiths were as good as those made in Bohemia; he even sent one of those gunsmiths to Lisbon to work for the Portuguese crown, presumably with a view to sharing with Portuguese military engineers the techniques in gun manufacture currently being used in western India.[31] One expert on guns of the period, Rainer Daehnhardt, speaks of an "Indo-Portuguese" tradition of matchlocks that were produced after 1510 in the arsenal of Portuguese Goa, the so-called Casa das Dez Mil Espingardas ("House of the Ten Thousand Guns").[32] This style of firearm would soon spread

[28] For the state of Ottoman gun technology in the sixteenth century, see Gabor Agoston, *Guns for the Sultan: Military Power and the Weapons Industry in the Ottoman Empire* (Cambridge: Cambridge University Press, 2005). For a discussion of the diffusion of Ottoman firearms technology in sixteenth century Asia, see Salih Ozbaran, "The Ottomans' Role in the Diffusion of Fire-arms and Military Technology in Asia and Africa in the Sixteenth Century," in Salih Ozbaran, *The Ottoman Response to European Expansion* (Istanbul: Isis Press, 1994), pp. 61–66.

[29] A Florentine merchant who participated in the Portuguese conquest of Goa mentioned that the defenders of its citadel "were almost all Turks, and renegade Christians of every sort; among whom were Venetians and Genoese in the largest numbers" (Sanjay Subrahmanyam, *The Political Economy of Commerce: Southern India, 1500–1650* [New York: Cambridge University Press, 1990], p. 255).

[30] Raymundo Antonia de Bulhão Pato and Henrique Lopes de Mendonca, eds., *Cartas de Affonso de Albuquerque* (Lisbon: Typ. da Academia real das sciencias de Lisboa, 1884), 1:28; cited in Daehnhardt, *Bewitched Gun*, p. 38.

[31] De Bulhão Pato and Mendonca, eds., *Cartas*, 1:174. Cited in Daehnhardt, *Bewitched Gun*, p. 39.

[32] Writes Daehnhardt, "The knowledge of Luso-German gunmaking, coming from Lisbon, was fused with the Goan and Arab knowledge which already existed in Goa, creating a completely new particular form, the Indo-Portuguese gunmaking [tradition]" (Daehnhardt, *Bewitched Gun*, p. 41).

not only into the Deccan interior but, by the mid-sixteenth century, throughout Portuguese Asia as far as Japan.[33]

In another letter sent to the king in December 1513, Albuquerque praised the abilities of Muslim gunsmiths in Goa who had formerly served the Bijapur sultanate and had fled after the Portuguese took that city, but who were induced to return to Goa and continue their work for the Portuguese crown. The viceroy even acknowledged—quite remarkably—that these gunsmiths had become "our masters in artillery and the making of cannons and guns, which they make of iron here in Goa and are better than the German ones."[34] Given that the Portuguese at this time considered guns made in Germany and Bohemia to be the finest anywhere,[35] Albuquerque's statement should serve as a corrective to the conventional image, tirelessly reinforced in history textbooks, of Europe as the undisputed font of military technology in the early modern era, and of the rest of the world as passive recipients of European technology. To the contrary, what we see here are gunsmiths in the western Deccan who had already assimilated earlier firearms technologies from Turkish and Portuguese sources, had amalgamated these traditions with their own, and were now transferring technologies in precisely the opposite direction, from India to western Europe.

## The Battle of Raichur, 1520

With Muslim gunsmiths of the western Deccan having made such remarkable achievements in gunpowder technology by the early sixteenth century, what were their consequences? An answer may be found in a single, decisive battle—actually a pair of battles—waged at and near the fort of Raichur in May and June 1520. Having passed from Bahmani to Bijapur's control in the late fifteenth century, Raichur had been an early player in military modernization under both Bahmani and 'Adil Shahi administrations. The contemporary Portu-

[33] Daehnhardt, *Bewitched Gun*, pp. 39–41. "The Portuguese," writes Daehnhardt, "received arquebuses, muskets and guns from Bohemia with this matchlock ignition system and used them in Portugal and in overseas explorations. Having arrived in Goa, these arms suffered technical evolution for more than thirty years (a human generation), finally finding their way, again through Portuguese hands, to the Far East and becoming the 'fathers' of Japanese, Javanese and Cingalese [*sic*] arms" (ibid., pp. 53–54).

[34] ". . . e asy se tornaram todolos oficiaees d artelharia, de bombardas e espimgardas, as quaees se fazem de ferro em goa milhores que has d alemanha" (De Bulhão Pato and Mendonca, eds., *Cartas*, 1:203; cited in Daehnhardt, *Bewitched Gun*, pp. 38–39).

[35] Daehnhardt, *Bewitched Gun*, p. 39.

guese horse merchant and chronicler Fernão Nunes reported that by the time of the battle we are considering, Raichur's 'Adil Shahi defenders had placed two hundred heavy cannon and many smaller cannon along the curtain walls between the fort's bastions, on which they had mounted thirty stone-hurling catapults (*trabuco*).[36] Nunes, who seems to have been an eyewitness to the battle of 1520,[37] was evidently referring here to cannon that were placed in the square gun ports that had been built into the fort's curtain walls when the walls were constructed in 1468–1470. In any event, Nunes's report is the earliest known European reference to the use of cannon anywhere in India's interior.

The Battle of Raichur followed a dispute between Vijayanagara and Bijapur over the purchase of warhorses, which both states had been importing from overseas through Portuguese Goa. Sometime in 1519 Krishna Raya entrusted a Muslim merchant with the sum of forty thousand *pardaos* to purchase warhorses from that port. But the merchant absconded to Bijapur, and when Krishna Raya demanded that Isma'il 'Adil Khan return both the merchant and the money, Isma'il refused to oblige. Enraged at the sultan's impudent behavior, Krishna Raya used the dispute to justify a full-scale invasion of Bijapuri territory, targeting Raichur evidently on the grounds that that fort had once belonged to Vijayanagara. In early 1520 the king moved north with a force of 27,600 cavalry and an immense infantry. In all, writes Nunes, the army included archers, cavalry using a variety of weapons, matchlockmen (*espimgardeiros*), swordsmen with shields, war elephants, and "several cannon" (*allgũs tiros de fogo*).[38]

Upon reaching Raichur, Krishna Raya concentrated his main attack on the fort's eastern side, near the present Kati Gate. Although the defenders fired on Vijayanagara's forces with cannon and matchlocks, together with arrows, Krishna Raya's besiegers used no artillery against

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[36] "Chronicle of Fernão Nuniz," in Robert, Sewell, trans., *A Forgotten Empire, Vijayanagara: A Contribution to the History of India* (1900; repr. New Delhi: Publications Division, 1962), p. 316.

[37] There is evidence that Nunes, who resided in metropolitan Vijayanagara for three years, had been living in coastal India since 1512. See Joan-Pau Rubiés, *Travel and Ethnology in the Renaissance: South India through European Eyes, 1250–1625* (Cambridge: Cambridge University Press, 2000), p. 204. Robert Sewell, who translated Nunes's account of the battle and also wrote the first modern history of Vijayanagara, notes that throughout Nunes's account of the battle, "there is much that impels the belief that either himself or his informant was present at the Hindu camp while these events were taking place" (Sewell, trans., *Forgotten Empire*, p. 148).

[38] "Chronicle of Fernão Nuniz," in Sewell, trans., *Forgotten Empire*, pp. 302–313; David Lopes, *Chronica dos Reis de Bisnaga: Manuscripto Inedito do Seculo XVI* (Lisbon: Impr. Nac., 1897), p. 28.

Raichur's walls. Instead, his commanders offered their men monetary inducements to approach the walls and dismantle them with crowbars and pickaxes, paying them in sums proportionate to the size of the stones dislodged. In this dreary manner the siege dragged on for three months.[39] Then, in early May 1520, while the siege was still in progress, Krishna Raya learned that Isma'il 'Adil Khan had marched down from Bijapur to relieve the embattled fort, and that the sultan had camped on the northern side of the Krishna river with eighteen thousand cavalry, 150 war elephants, and considerable infantry. He also brought along a substantial amount of field artillery. Suspending his siege at Raichur, Krishna Raya moved his entire army up to the Krishna River to prevent Bijapur's forces from entering the Doab. A pitched battle between the two armies began several hours after dawn on 19 May 1520, when the sultan, having moved his forces to the southern side of the river, ill-advisedly fired all his artillery at once into Vijayanagara's massed front lines. When those lines broke, Krishna Raya mounted his horse and moved forward with his remaining divisions of heavy cavalry. Not having sufficient time to reload their cannon, the Bijapuri artillery corps was evidently encircled by Vijayanagara's cavalry, which forced the Bijapuris to abandon their ordnance and take flight. The main part of Bijapur's army was driven back toward, and finally into, the Krishna River. This was followed by horrific slaughter. Many 'Adil Shahi forces drowned attempting to recross the river; others were picked off by Vijayanagara's archers while in the water or while scrambling ashore. In the midst of the chaos, Isma'il 'Adil Khan managed to jump on an elephant, barely escaping with his life.[40]

Having soundly defeated the Bijapuris on the battlefield, Vijayanagara's army now returned to Raichur to resume its siege of the fort. At this point a new factor enters Nunes's narrative: the arrival of twenty Portuguese mercenaries who, led by one Cristovão de Figueiredo, had just joined Krishna Raya's forces at Raichur as matchlockmen.[41] Noticing how fearlessly Bijapuri defenders roamed about the fort's walls, fully exposed to the view of the besiegers, de Figueiredo and his comrades

[39] "Chronicle of Fernão Nuniz," in Sewell, trans., *Forgotten Empire*, pp. 315–316.

[40] Sewell, trans., *Forgotten Empire*, p. 323.

[41] Although European mercenaries and renegades had begun appearing in the service of Indian coastal powers as early as 1502, this was the first major conflict in the Indian interior in which Europeans are known to have participated. See Maria Augusta Lima Cruz, "Exiles and Renegades in Early Sixteenth Century Portuguese India," *Indian Economic and Social History Review* 23, no. 3 (1986): 258, 260; Sewell, trans., *Forgotten Empire*, pp. 325, 326.

began picking them off with their guns, allowing Krishna Raya's men to resume dismantling the walls relatively unhindered. This operation proved so successful that the defenders were forced to abandon their first line of fortification and place their women and children in the city's hilltop citadel.[42] A turning point in the siege was reached on 14 June, when the governor of the city, seeking a better view of exactly where the Portuguese snipers were positioned, leaned out in front of one of the merlons and was instantly killed by a matchlock shot that struck his forehead. This so snapped the morale of Raichur's defenders that they promptly abandoned the wall. The next day the Bijapuris opened the city gate and filed out, begging for mercy, and the day after that, Krishna Raya formally took possession of the city.[43]

What can this battle tell us about the state of gunpowder weaponry in the early sixteenth-century Deccan? The first thing to notice is its counterintuitive outcome, which probably explains its absence in the historical literature. On the one hand, the battle's winners, Vijayanagara, are said to have left their capital with only "several" cannon, and they used little if any artillery either at Raichur fort or in the pitched battle by the river. On the other hand, the losing side, Bijapur, possessed and used considerable artillery both offensively by the Krishna River and defensively at Raichur fort—a consequence of the rapid development of firearms technology in the arsenal at Goa when that city was under first Bahmani and then 'Adil Shahi control (1472–1510). We know that Isma'il 'Adil Khan, unlike Krishna Raya, brought a great deal of ordnance to the battlefield. As Nunes reports, his retreating army was forced to abandon four hundred heavy cannon and nine hundred gun carriages, in addition to four thousand warhorses and one hundred elephants.[44] In fact, writes Nunes, Isma'il had boldly entered the Raichur Doab because he was confident that the great strength of his artillery (*a gramde artelharya*) would give him a quick

[42] Sewell, trans., "Chronicle of Fernão Nuniz," pp. 326–327.

[43] Ibid., pp. 329–330. Nunes explicitly writes that the captain leaned his body out in front of a merlon (*deitamdo o corpo amte húas ameyas*), even though the parapet of Raichur's wall was continuous, and not divided into merlons and embrasures. Since Nunes was writing some ten years after the battle, and this is a very unusual disposition for a parapet, he is probably misremembering this detail of the fortifications at the site. We are grateful to Javier Castro-Ibaseta for his his help in interpreting this passage in the original Portuguese text.

[44] "Quoatro centos tiros grossos d artelharia, afora meuda, forão o numero das carretas d ellas nove-centas . . ." (Lopes, *Chronica*, p. 39; Sewell, trans., *Forgotten Empire*, p. 326). Cannon and gun carriages are often enumerated separately in sixteenth-century sources, and the number of carriages is generally at least double that of the cannon, so as to provide replacements when existing carriages were damaged.

victory. Indeed, the sultan's opening barrage did give him temporary field advantage. And yet he lost.

Second, it is clear that Bijapur's deployment of cannon proved fatally ineffective both offensively, when deployed in the pitched battle by the river, and defensively, when mounted along the fort's curtain walls. In the pitched battle, Bijapur's gunners evidently made the tactical mistake of firing all their cannon at once, instead of staggering their volleys. As a result, they could not reload and fire successive rounds of shot quickly enough before being overwhelmed by Vijayanagara's swift and powerful cavalry. Things went no better at Raichur's fort. There, as Nunes makes clear, Bijapur's gunners were unable to maneuver their cannon so as to screen the walls with flanking fire.[45] Being fixed in their gun ports along the fort's curtain walls, the cannon were virtually immobile and hence of little value against besiegers who managed to approach the wall beneath them.

Finally, and perhaps most importantly, the antagonists in this battle appear to have drawn directly opposite conclusions from its outcome. The losing Bijapuris understood that, despite the advances in cannon technology already made at their Goa arsenal, they had much to learn about the deployment of field cannon. They would need considerable practice before this new technology could become truly lethal to opponents who had mastered the tactics and techniques of cavalry warfare. Similarly, at Raichur, the military engineers' conservative approach to mounting cannon on the fort's ramparts proved to be their own undoing. Owing to the arrangement of the fort's defenses—thirty stone-hurling catapults placed on the bastions and several hundred heavy and light cannons fixed along the curtain walls in immobile positions—each shot fired from those cannons would tend to land in nearly the same, predictable spot in front of the fort. As a result, Krishna Raya's men were able to dismantle a portion of the city's walls without suffering prohibitively high casualty rates. In short, Bijapur's forces at Raichur fort deployed the new gunpowder technology in a manner that proved just as disastrous there as did their deployment of cannon in the pitched battle by the Krishna River. Yet, crucially, Bijapur's political leaders chose not to abandon the new technology that had so decisively failed them at Raichur. To the contrary, they and their engineers would mount an accelerated drive to master the use of cannon both defensively and offensively.

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[45] Writes Nunes, "The King's people came without fear to the wall, where already it was damaged in many places, because the city had its cannon so high up that these could do no injury to the men who were at the foot of the wall" (Sewell, trans., *Forgotten Empire*, p. 327).

It is often the case that states assimilate new technologies by a gradual process of trial and error, in respect to which failures can be as important as successes. Such is what happened at Bijapur.

Meanwhile, Krishna Raya, though evidently impressed with the effectiveness of the matchlocks used by his Portuguese mercenaries, failed to see cannon warfare as the wave of the future. Prevailing against Bijapur's artillery both in pitched battle and at the fort seems to have reconfirmed the king's confidence in the efficacy of the day's conventional warfare. Accordingly, we find no evidence that he followed up his victories by establishing an arsenal or matchlock foundry in his kingdom. Nor did he or his successors ever mount cannon on the walls of their capital or their provincial forts, or in other ways adapt their defensive systems so as to accommodate gunpowder technology, a point established with respect to metropolitan Vijayanagara in a recent study by Robert Brubaker.[46] For the rest of its existence, the Vijayanagara state simply failed to take gunpowder technology very seriously. Whereas defeat at Raichur would catalyze Bijapur to embark on a remarkable drive for military modernization, victory lulled Krishna Raya and his successors into a state of relative complacency—a mistake for which they would later pay a very heavy price.

## The Evolution of Gunpowder Weaponry and Fortifications, 1520–1600

Bijapur's military engineers appear to have closely studied the reasons for their devastating defeat at Raichur, for in the course of the next forty years they formulated a series of technological solutions that were

[46] Concludes Brubaker, "Vijayanagara's defenses were [n]ever modified in any way to either take advantage of, or compensate for, respectively, the new possibilities or new threats posed by gunpowder weaponry." Or again: "With respect to measures that could have been taken to strengthen the defenses in the face of assaults conducted using artillery, evidence is wholly lacking. Thus, for example, later walls were not constructed within wide ditches in order to make these less vulnerable to artillery fire while at the same time retaining their value as barriers to the advance of infantry . . . Similarly, although each of Vijayanagara's defensive circuits itself varies in thickness, the later defenses are not any thicker than the earlier walls, nor is there evidence to suggest that the thickness of any was augmented in order to increase its ability to withstand assault by artillery. Finally, although the walls everywhere appear to have been similar in height to the bastions, and although the parapet walkways were clearly wide enough along some stretches to facilitate the movement of artillery pieces, other stretches are clearly narrow enough that this task could likely have been performed only with some difficulty." See Robert Brubaker, "Cornerstones of Control: The Infrastructure of Imperial Security at Vijayanagara, South India" (PhD diss., Department of Anthropology, University of Michigan, 2004), pp. 452, 453.

both creative and far-reaching.[47] Although contemporary accounts are largely silent on this development, our examination of a considerable body of material evidence—more than a hundred specimens of early modern cannon surviving at sixteen Deccani forts—speaks to the matter with clarity.

To appreciate the strides made by Bijapur's engineers in the decades following the Battle of Raichur, it is important to recognize the level of military technology available to them in 1520. The guns used to defend Raichur were almost certainly wrought iron breech loaders, similar to those used in contemporary western Eurasia (Fig. 2).[48] These guns were made from a series of long iron staves that formed the inner barrel and were bound together by tightly fitted iron bands and reinforcing hoops that were forge-welded together.[49] As breech loaders, they had two detachable parts: a barrel open at both ends and a separate powder chamber, closed at the breech, with a narrower flange at the front end made to fit into the bore of the barrel. The advantage of the removable chambers was that the powder could be loaded into them directly and quickly, without having to ram it down a barrel still hot from the previous firing. But their two-part construction also meant that they had to be immobilized on heavy wooden carriages designed to keep the powder chamber tightly fitted into the barrel.[50] Such a mounting

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[47] Whereas most of the technological initiative appears to have been taken by engineers serving the 'Adil Shah sultans of Bijapur, the neighboring kingdoms of Ahmadnagar and Bidar were also active in assimilating the new military innovations, together with their architectural implications. By contrast, Golconda, the easternmost sultanate of the sixteenth-century Deccan, lagged behind its neighbors to the west in modernizing its military profile, while Vijayanagara assimilated none of these innovations.

[48] We know from Afonso de Albuquerque's 1513 correspondence with the king of Portugal that Bijapur's gun foundry in Goa was then manufacturing cannons made of iron (see n. 34 above). There is no evidence that cast bronze cannons appeared in the Deccan before 1543, which is the manufacture date of such a gun made by a Turkish smith and located on the northeastern bastion of the fort of Ausa. Throughout the sixteenth century, the number of forged iron cannons continued to dominate over those of cast bronze, owing mainly to the much greater expense of copper, the chief alloy used in cast bronze ordnance.

[49] See Robert D. Smith, "The Technology of Wrought-Iron Artillery," *Royal Armouries Yearbook* 5 (2000), pp. 68–79; Robert D. Smith, "Towards a New Typology for Wrought Iron Ordnance," *International Journal of Nautical Archaeology and Underwater Exploration* 17 (1988), pp. 5–16. For the history of wrought-iron cannons made in the eastern Deccan, see S. Jai Kishan, "Forge-Welded Cannons in the Forts of Karimnagar District in Andhra Pradesh," *Indian Journal of History of Science* 40, no. 4 (2005): 487–501.

[50] Carriages have not been preserved in any of the Deccani examples we have documented, but in all likelihood they would have been similar in general design to those used contemporaneously in the Middle East and Europe. These carriages are best represented by a number of well-preserved specimens recovered from the wreck of the *Mary Rose*, an English warship that sank in Portsmouth harbor in 1545. See Peter Marsden, *Sealed by Time: The Loss and Recovery of the Mary Rose* (Portsmouth: Mary Rose Trust, 2003), fig. 12.21.

system, combined with the small, square gun ports built into Raichur's parapets, seriously restricted the guns' maneuverability, especially their vertical movement.

Building on technical features borrowed from western Eurasia, in the decades following the Battle of Raichur, Deccani gun makers pioneered technological breakthroughs that were without precedent. Strategically, their goal was to build a new generation of guns that could control a wide swath of territory lying before a fort in order to prevent attackers from approaching its walls with siege equipment, or even with pickaxes, as Vijayanagara's soldiers had done at Raichur fort. To do this, they aimed to replace the earlier technology of stone-flinging catapults, which had theretofore been used on bastions, with large wrought iron or cast bronze muzzle loaders that could be rotated both laterally and vertically. In the course of our field research, we personally examined a total of 107 cannons at Bidar, Bijapur, Devarakonda, Elgandal, Golconda, Kalyana, Kandhar, Malkhed, Medak, Mudgal, Naldrug, Parenda, Raichur, Shahapur, Udgir, and Yadgir. Only about a dozen of those that are dated were made in the sixteenth or seventeenth centuries. Yet the information they contain, combined with analysis of the more numerous undated cannons we examined, nonetheless suggests trends in early modern metallurgy in the Deccan.

The guns themselves varied widely in size, typically ranging from two to five meters in length, with the longest exceeding nine meters; their bores typically ranged from fifteen to forty centimeters in diameter, with the largest exceeding seventy centimeters. Guns associated with the various sultanates also bore distinctive characteristics. For example, the Nizam Shahi sultans of Ahmadnagar led the other sultanates in the art of casting high-quality bronze cannon, a skill evidently acquired from immigrant Ottoman Turkish master gunsmiths who had been recruited by the Nizam Shahi rulers of Ahmadnagar.[51] Taking advantage of their proximity to Arabian Sea shipping lanes, these sultans also acquired arms made in Europe.[52] For their part, the 'Adil

[51] The three earliest datable cast bronze guns—Ausa no. 1 (950/1543), Bijapur's "Malik-i Maidan" (956/1549), and Udgir no. 1 (undated, but also made by the same founder)—were all made by a single gunfounder, Muhammad bin Husain Rumi, whose *nisbah* indicates that he was an immigrant from Ottoman Turkey, where bronze gunfounding had achieved a high level of perfection already by the late fifteenth century. All three guns were made for the Nizam Shahi sultan. Of the total of thirteen cannons found at the fort of Parenda, a Nizam Shahi stronghold, nearly all were made of cast bronze.

[52] One of the bronze guns at their fort at Parenda was originally manufactured in 1627 by Everhard Splinter at Enkhuizen in Holland for the Dutch East India Company. We identified another imported gun, located on the northwestern bastion of the Nizam Shahi fort

Shahi sultans of Bijapur manufactured a great many wrought iron cannon that, while certainly serviceable, were hardly the highly polished works of art produced by either of their neighbors. As we will see, their energies were mainly devoted to pioneering innovations in mounting systems and bastion design. Farther to the east, the Barid Shahi sultans of Bidar made forge-welded iron cannon of exceptionally high quality, polished to such a degree as to be nearly indistinguishable from cast bronze. Many of them are also beautifully decorated with floral or animal designs in metal inlay, with cartouches containing lines of Persian verse or passages from the Qur'an.[53] By contrast, the Qutb Shahi sultans of Golconda, the easternmost sultanate, lagged far behind the others in terms of both bastion design and cannon manufacture.[54]

To accomplish the goal of mounting these huge cannon atop the bastions of Deccani forts, several engineering breakthroughs were needed. In particular, two technological innovations proved crucial, both of them pioneered by engineers in Bijapur's service. In order to give their cannons vertical movement, engineers borrowed the western Eurasian device of the trunnion, that is, the cylindrical pivot projecting from the sides of a cannon's barrel, permitting it to be raised or lowered independent of the carriage on which it was mounted. Both European and Ottoman engineers had been building cannons with trunnions in the early sixteenth century, and we have clear evidence that this technology diffused to the Deccan at that time. On the northeastern bastion at Ausa lies a bronze Ottoman-style muzzle loader with trunnions. An inscription on its barrel indicates that it had been made for Sultan Burhan Nizam Shah I of Ahmadnagar in 1543 by an immigrant Ottoman gun founder named Ustad Muhammad bin Husain Rumi.[55] Likely

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at Ausa, that was originally made for King Philip III of Spain (r. 1598–1621). Whether the Nizam Shahis purchased these guns or seized them as battle spoils is unknown.

[53] Bidar's tradition of high-quality metalworking in cannon production is consonant with that city's renown for the production of fine inlaid metalware for domestic use, so-called Bidri ware, which also emerged in the Barid Shahi period. See Susan Stronge, *Bidri Ware: Inlaid Metalwork from India* (London: Victoria and Albert Museum, 1985).

[54] The cannons we found on Qutb Shahi forts—all of them wrought iron and some of them breech loaders—were the crudest of the lot. The only record of a remodeled bastion constructed in the Qutb Shahi domain appears as late as 1602, at Medak. Moreover, the gun on this bastion is a breech-loading tube gun—a type that had been common in Europe in the mid fifteenth century. As for the Qutb Shahi capital itself, when the Mughals conquered Golconda in 1687, they replaced many of the fort's wrought iron cannons with the same cast bronze guns the victors had used to reduce the fort (Jean Deloche, "Gunpowder Artillery and Military Architecture in South India [15–18th century]," *Indian Journal of History of Science* 40, no. 4 [2005]: 584).

[55] The date's third digit on the gun is indistinct, but it is most likely a zero, which would give the manufacture date as 950 A.H., or 1543–1544.

used as a field cannon before being fixed on a bastion, this gun suggests the pathway by which the trunnion concept reached the Deccan.

To give a cannon lateral movement, Deccani engineers took from the Portuguese the idea of mounting a gun on a swivel fork attached to the gun's trunnions. The Portuguese had been using such a mounting device on small cast bronze or wrought iron breech loaders called *berços*, or "cradles"—so called because of the open space behind their barrels to accommodate a removable powder chamber. The swivel fork beneath the barrel mounted on the gun's trunnions gave the gun both vertical and lateral movement. Measuring only a meter or so in length, *berços* were commonly mounted on the gunnels of sixteenth century Portuguese ships.[56] We have seen that when the Portuguese were defeated off the port of Chaul in 1508, guns of this particular type were among the weapons that the victors plundered from Portuguese vessels and took to Goa, then a Bijapuri possession. Once brought ashore, they were swiftly integrated into Goa's gun foundry and arsenal, for locally made wrought iron copies of these European models soon appeared in the interior (Fig. 3).[57] These are the guns referred to in Indian sources as *firangi*—literally "Frankish"—with reference to their Portuguese inspiration.[58]

In the 1550s, engineers at Bijapur's hill fort at Yadgir, not far north of Raichur, appear to have taken the lead in creatively adapting the principle of trunnions and swivel forks for directly mounting massive cannons atop bastions, something that until then had never been attempted in Europe or elsewhere. Four of Yadgir's cannons were evidently built sequentially, as each gun introduced different degrees of

[56] This can be inferred both from excavated shipwrecks of this period and from a 1525 gun list from Portuguese India. See Robert Douglas Smith, "Bronze Breech-Loading Swivel Guns: A Preliminary Survey," in Gert Groenendijk and Jan Piet Puype, eds., *A Farewell to Arms, Studies on the History of Arms and Armour* (Delft: Legermuseum, 2004), pp. 167–169; Joe J. Simmons III, "Wrought-Iron Ordnance: Revealing Discoveries from the New World," *International Journal of Nautical Archaeology and Underwater Exploration* 17, no. 1 (1988): 25–34; Donald H. Keith, "Shipwrecks of the Explorers," in George F. Bass, ed., *Ships and Shipwrecks of the Americas* (New York: Thames and Hudson, 1996), pp. 45–68; Richard Barker, "A Gun-List from Portuguese India, 1525," *Journal of the Ordnance Society* 8 (1996): 53–56.

[57] Such guns can be found in various forts in the western Deccan, such as at Ausa, Naldrug, and Parenda.

[58] Interestingly, Portuguese *berços* were also introduced to China in the early sixteenth century, where they were also copied and referred to as "Frankish" (*fo-lang-chi* in Chinese). See Joseph Needham, Ho Ping-Yü, Lu Gwei-Djen, and Wang Ling, *Science and Civilisation in China. Volume 5, Chemistry and Chemical Technology, Part 7: Military Technology; the Gunpowder Epic* (Cambridge: Cambridge University Press. 1986), pp. 367–376.

Figure 3. Ausa fort. A local Indian copy of a Portuguese *berço*, probably mid sixteenth century. A swivel fork would have been fitted on to the trunnions, and its lower end would have been affixed into the wall or floor of the fort. The removable powder chamber was fitted into the open space behind the barrel, and a metal wedge driven through the rectangular hole on the side to keep it tight against the breech end of the barrel.

improvements or refinements not found in its predecessors. Since an inscription on the third cannon in this sequence records that it was made in 1557 by one Muhammad Aqa, we may infer that the late 1550s saw the active phase of this experimentation, and that this unsung engineer was the creative force behind it.[59] Muhammad Aqa's technological innovation consisted of several interlinked components that together allowed a single gun to command an unusually wide swath of terrain. First, it involved fixing the gun directly to the fort by means of a modified swivel fork, which was made from a cubic block of granite

[59] An inscription on the cannon's muzzle records that it was made "Under the superintendence of Muhammad Aqa, 1557" (*dar karkard-i Muhammad Aqa, tas'a mah satin hams*) (*Epigraphia Indo-Moslemica* [1929–1930], p. 3).

FIGURE 4. Yadgir fort. Cannon no. 4, mounted on granite swivel block, ca. 1560. This is the final gun in the series of four swiveling muzzle loaders engineered by Muhammad Aqa at Yadgir fort in the 1550s. The breech end of this gun (left) has been broken off; when intact it would have measured approximately 728 centimeters, and it has a bore of 22 centimeters. It is mounted on a massive cavalier at the highest point of the fort, giving it a full 360 degrees of coverage.

set on an iron pin to enable the gun to swivel from side to side (Fig. 4). Second, it necessitated affixing trunnions to the gun's barrel and cutting channels into the surface of the block to accommodate both the trunnions and the body of the barrel as it was raised and lowered. Third, to take advantage of the flexibility of aiming that this mounting system provided, the gun was mounted not on the wall of the fort, but either on a semicircular bastion projecting from it—where it could cover an arc of nearly 180 degrees—or on a separate circular gun platform at the very top of the fort, allowing a full 360 degrees of coverage. In effect, the gun was being treated as a massive, oversized *berco*, with the result that a single gun could cover a much broader area in front of the fort.

A final innovation seen at Yadgir was the construction of a deep

circular channel near the edge of the platform. By positioning a heavy wooden post into this channel at the point directly behind the cannon's breech, and driving a wooden wedge between the breech and the post's inner surface, some of the recoil force would have been absorbed and transmitted to the heavy stone construction of the gun platform.[60] This last innovation, however, evidently proved inadequate for the task, as is witnessed by the fractured state of two of Yadgir's four stone mounting blocks and our discovery of an extra mounting block that was being held in reserve near the base of the cavalier of Yadgir no. 4. Since such stone mounting systems are extremely rare in the Deccan,[61] it seems that this aspect of Muhammad Aqa's experiment represented something of a developmental dead end.

By about 1560, however, solutions to this problem were worked out at several other hill forts—e.g., Kalyana, Naldrug, Parenda, and Kandhar—along Bijapur's northern border with the Nizam Shahi sultanate of Ahmadnagar. These solutions required engineers to go beyond experimenting with the guns and their mounting systems, and to make fundamental changes in the architecture of the fort itself. The remodeling of Kalyana in the 1560s by Bijapur's Sultan 'Ali 'Adil Shah illustrates the process.[62] Existing bastions, apparently dating to the Bahmani period, were completely rebuilt as massive solid platforms and provided with a distinctive new type of crowning cavalier rising above the top of the bastion. At most of these bastions, the guns were mounted on heavy wrought iron swivel forks, while the rear portion of the cavalier was carried up to provide a continuous solid recoil wall (Figs. 5 and 6). Driving a wooden wedge between the breech of the cannon and the recoil wall would have absorbed the force of the gun when it was fired, taking the strain off the iron swivel far more effectively than had the system earlier attempted at Yadgir.

The earlier bastions of these remodeled forts were apparently filled in with earth, with some of their masonry recycled in the outer facing of the new bastions. The end result was a massive platform of solid earth, encased within strong stone masonry and girded about the top with a continuous parapet of alternating merlons and embrasures.

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[60] We owe this insight to our colleague John Friedrich, who accompanied us on our visit to Yadgir.

[61] At least one other such mounting device is reported from the nearby fort of Shahapur. Personal communication from Klaus Rotzer.

[62] Because many of Kalyana's remodeled bastions are dated, we are in an especially good position to reconstruct the sequence of that fort's modernization. See Table 1.

Figure 5. Kalyana fort. Forge-welded wrought-iron muzzle loader (cannon no. 8), mounted on bastion no. 8 (dated 1573) in the lower circuit. The gun is mounted on a large swivel fork fixed into a socket in the floor of the cavalier.

Figure 6. Kalyana fort. Detail of cannon no. 8, showing the swivel fork.

Atop this massive platform, the cavalier rises up to yet another level (Fig. 7). This two-tiered disposition permitted an effective spatial differentiation between the higher level occupied by the cannon and its firing crew, and the battlement below with its loop-holed merlons and embrasures for small arms fire. The platform on the higher level was protected by a two-part masonry wall, articulated along the outer edge as a series of merlons and embrasures, and at the rear as the solid recoil wall described above. Pairs of sockets near the tops of the sides of the merlons were intended to hold small wooden beams for affixing wooden shutters, which would have been kept closed on all sides except the one through which the gun was being fired, thus sheltering the gun crew from incoming small arms fire.

If building high cavaliers on existing bastions gave a fort's big guns greater range, a further innovation—perhaps the ultimate step in this direction—was the introduction of immense freestanding stone cavaliers that towered far above all the bastions, and sometimes above the entire fort. On the top of such cylindrically shaped platforms, cannons mounted on swivel forks commanded a 360-degree sweep of the fort's surrounding countryside. One of the earliest of these to appear was at

FIGURE 7. Kalyana fort. Bastion no. 10 (dated 1568) in the lower circuit, viewed from above rear, showing the recoil wall and merlons of the cavalier.

Yadgir, where Muhammad Aqa had experimented with mounting large cannon on swivel mounts in the late 1550s. In the following several decades, gigantic cavaliers with great guns began appearing at other strategic 'Adil Shahi forts. At Naldurg sometime after 1560, engineers placed two large cannons on a massive cavalier twenty-seven meters high and twenty meters in diameter at the top, accessible by a long staircase of seventy-seven steps (Fig. 8).[63] Almost as high is Bijapur's Haidari Burj, a cavalier built in 1583 that rises to a height of about twenty-four meters and carries one of the longest cannons in India, the "Lambacharri" gun, measuring 9.32 meters.[64] One of the most spectacular such structures is found in Mudgal, where an enormous cylindrical

[63] Jean Deloche, *Studies on Fortification in India* (Pondicherry: École Française d'Extrême-Orient, 2007), p. 107. An inscription on the Jami' mosque in Naldurg states that the mosque and the fort were both built in 1560. This date could refer either to the date that the entire fort, including the cavalier, was completed, or the date that its construction was begun (*Epigraphia Indo-Moslemica* [1917–1918], p. 2, plate I-b).

[64] Deloche, *Studies*, p. 109.

Figure 8. Naldurg fort. Cavalier, ca. 1560.

tower was raised nine meters high and twenty-eight meters in diameter. Since the cavalier was built at the peak of a hill in the middle of the fort's enclosure, the gun that was once mounted on its platform—it is not there today—would have had a commanding 360-degree sweep over the whole of the surrounding countryside.[65]

In short, the mid sixteenth century saw fundamental changes in the Deccan's architectural landscape as fortifications built in the pre-gunpowder age were rebuilt to accommodate the new style of mounting cannons. Table 1, which documents the construction of new bastions in the Deccan, shows the chronology of the new system's diffusion across the plateau. Of the forty-five dated bastions built between 1500 and 1600, fully three-quarters (thirty-five) were built during the thirty years between 1560 and 1590—clearly the period when rulers and governors most feverishly raced to remodel their forts. Moreover, two-thirds (thirty) of those forty-five bastions were built by rulers of Bijapur, whose lead in this activity may be attributed to several factors. First, the 'Adil Shahis' location in the western portion of the plateau gave them direct access to new ideas arriving from across the Arabian

[65] Jean Deloche, *Four Forts of the Deccan* (Pondicherry: École Française d'Extrême-Orient, 2009), 60. Apart from Naldrug and Mudgal, similar structures can be found at Elgandal, Malkhed, and Raichur.

Sea, such as the trunnion and the swivel fork. Second, Isma'il 'Adil Khan's stunning defeat at Raichur in 1520 seems to have inspired his successors to compensate for their humiliating loss by mastering the techniques of cannon warfare. Isma'il's immediate successor, Ibrahim I (r. 1535–1558), oversaw the innovative experiments at Yadgir that launched the Deccan's military transformation. But it was in 'Ali's reign (r. 1558–1580) that that transformation truly took off. No Deccan ruler played a more active role in modernizing the military profile of the Deccan's forts.

The third reason Bijapur was such a military pioneer was that that state emerged as by far the greatest beneficiary of Vijayanagara's catastrophic defeat in the 1565 Battle of Talikota. Loot plundered from their fabulously rich rival to the south enabled 'Ali to embark on massive investments in military modernization throughout his domain.

## The Battle of Talikota, 1565

If the battlefield is the ultimate test for any weapon system, the Battle of Talikota, waged in 1565, revealed the wide gap in military technology that had opened between the northern and southern Deccan since the Battle of Raichur, fought forty-five years earlier. Indeed, the two battles appear to have been linked in a curious way. In 1520, having crushed Isma'il 'Adil Khan both at Raichur fort and in the nearby pitched battle, Krishna Raya chose to adopt a posture of contemptuous arrogance toward his defeated foe. First, the Vijayanagara king promised to return the spoils of his victory to Isma'il on the sole condition that the latter come down to his court and show his submission by kissing his foot.[66] When the Bijapur sultan refused, Krishna Raya humiliated his adversary further by marching to Isma'il's own capital—which, still lacking a fortified citadel, the sultan had prudently vacated—and occupying it for several days. Participating in these audacious maneuvers was Vijayanagara's ambitious courtier Rama Raya, who had married one of Krishna Raya's daughters. Soon after the king's death in 1529, Rama Raya began laying the groundwork for his own takeover of the Vijayanagara state, which came to fruition in 1550 when he placed its de jure sovereign, Sadasiva, under effective house arrest and began governing the kingdom as an autocrat. At the same time, he continued his father-in-law's arrogant policies toward Bijapur and the

[66] Sewell, trans., *Forgotten Empire*, p. 335.

Table 1. Dated Bastions of the Deccan, 1500–1600

| Date | Site | District | Name of Bastion | Sovereign | Builder | Source |
|---|---|---|---|---|---|---|
| 1512 | Panhala | Kolhapur | — | — | Sikandar | *EIAPS* (1971), p. 67, pl. XVII(b) |
| 1515 | Raichur | Raichur | "Burj al-Fath" | Mahmud Bahmani | — | *EIM* (1939–1940), p. 16, pl. VI(a) |
| 1539 | Panhala | Kolhapur | — | Ibrahim 'Adil Shah I | Yusuf the Abdar | *EIAPS* (1971), p. 68, pl. XVIII(b) |
| 1546 | Raichur | Raichur | — | Ibrahim 'Adil Shah I | Ahmad Haji | *EIAPS* (1963), p. 62, pl. XIX(a) Gunabadi |
| 1548 | Raichur | Raichur | — | Ibrahim 'Adil Shah I | — | *EIAPS* (1963), p. 63, pl. XX(a) |
| 1558 | Gulbarga | Gulbarga | "Burj-i Daulat" | 'Ali 'Adil Shah I | 'Arab Khan[1] | *EIM* (1907–1908), p. 2 [no plate]; see also Desai, *South India*, no. 573 |
| 1558 | Gulbarga | Gulbarga | Putli Burj | 'Ali 'Adil Shah I | 'Arab Khan | Desai, *South India*, no. 574[2] |
| 1560 | Kalyana | Bidar | Lower bastion no. 1 | 'Ali 'Adil Shah I | — | Unpublished Marathi inscription; located on inside upper face of bastion |
| 1560 | Naldurg | Osmanabad | "completed the fort" | 'Ali 'Adil Shah I | Nimatullah, son of Khwaja Isma'il Kurd Khiraji of Nihawand | *EIM* (1917–1918), p. 2, pl. I(b) |
| 1561 | Bijapur | Bijapur | Tabut Burj | 'Ali 'Adil Shah I | — | Nazim, *Bijapur Inscriptions*, p. 49, pl. VI |
| 1563 | Kalyana | Bidar | Lower bastion no. 5 | 'Ali 'Adil Shah I | Kamil Khan | *EIM* (1935–1936), p. 5, pl. IV(a) |
| 1564 | Gulbarga | Gulbarga | — | 'Ali 'Adil Shah I | Khan-i A'zam Hamid Khan Bahmani | *EIM* (1907–1908), 3[3]; see also Desai *South India*, no. 577 |
| 1564 | Gulbarga | Gulbarga | [2 bastions constructed, acc. to previous inscription] | 'Ali 'Adil Shah I | Khan-i A'zam Hamid Khan Bahmani | *EIM* (1907–1908), p. 3[3]; see also Desai *South India*, no. 577 |
| 1565 | Raichur | Raichur | "Shah-i Burj" | 'Ali 'Adil Shah I | Ikhlas Khan | *EIM* (1939–1940), p. 17, pl. VII(a) |
| 1565–1589 | Kandhar | Nanded | — | Murtaza Nizam Shah I | Ghori Khan | *EIM* (1919–1920), p. 22, pl. X(b) |

*Continued on next page*

Table 1 (*continued*). Dated Bastions of the Deccan, 1500–1600

| Date | Site | District | Name of Bastion | Sovereign | Builder | Source |
|---|---|---|---|---|---|---|
| 1566 | Kandhar | Nanded | — | Murtaza Nizam Shah I | Pulad Khan | *EIM* (1919–1920), p. 22, pl. X(a) |
| 1566 | Galna | Nasik | — | Murtaza Nizam Shah I (?) | Aflatun Khan | *EIAPS* (1967), p. 45, pl. XI(b) |
| 1567 | Kalyana | Bidar | Lower bastion no. 6 | ʻAli ʻAdil Shah I | Kamil Khan | *EIM* (1935–1936), p. 5, pl. IV(b) |
| 1568 | Kalyana | Bidar | Lower bastion no. 10 | ʻAli ʻAdil Shah I | Kamil Khan | *EIM* (1935–1936), p. 6, pl. V(b) |
| 1569 | Dharur | Bhir | "Burj-i ʻAli" | ʻAli ʻAdil Shah I | Kishwar Ghazi | *ARIE* 1965–1966), D, p. 190; see also Desai, *Western India*, no. 829[4] |
| 1569 | Galna | Nasik | "Fathi Burj" | Murtaza Nizam Shah I | Aflatun Khan | *EIAPS* (1957–1958), p. 13, pl. IV(b) |
| 1570 | Raichur | Raichur | — | ʻAli ʻAdil Shah I | Tahir Khan | *EIAPS* (1963), p. 65, pl. XIX(b) |
| 1573 | Kalyana | Bidar | Lower bastion no. 8 | ʻAli ʻAdil Shah I | Kamil Khan | *EIM* (1935–1936), p. 7, pl. V(c) |
| 1574 | Mudgal | Raichur | ʻAli Burj | ʻAli ʻAdil Shah I | — | *EIM* (1935–1936), p. 16, pl. X(a) |
| 1574 | Gulbarga | Gulbarga | — | ʻAli ʻAdil Shah I | Babaji Dabit Khan | *EIM* (1907–1908), p. 3 [no plate]; see also Desai, *South India*, no. 581 |
| 1576 | Bijapur | Bijapur | Firingi Burj | ʻAli ʻAdil Shah I | — | Nazim, p. 50 |
| 1576 | Janjira | Kolaba | "constructed the fort and bastions" | Murtaza Nizam Shah I | Fahim Khan | *ARIE* (1959–1960), D, p. 140; see also Desai, *Western India*, no. 1110 |
| 1577 | Dharur | Bhir | "Burj-i Hazrat-i Diwan-i A'la Murtazashahi" (Hathi Burj) | Murtaza Nizam Shah I | Ahmad Aqa | *ARIE* (1965–1966), B, p. 353; see also Desai, *Western India*, no. 831 |
| 1577 | Gawilgarh | Amravati | "Burj-i Bahram" | Murtaza Nizam Shah I | Bahram | *EIM* (1907–1908), p. 11 [no plate] |
| 1577 | Panhala | Kolhapur | "Burj-i Qudrat" | ʻAli ʻAdil Shah I | Shams al-Din | *EIAPS* (1971), p. 73, pl. XIX(a) |
| 1579 | Dharur | Bhir | Twelve Imams Burj | Murtaza Nizam Shah I | Turk Khan | *ARIE* (1965–1966), D, p. 189; see also Desai, *Western India*, no. 832 |
| 1579 | Galna | Nasik | Murad Burj | Murtaza Nizam Shah I | — | *EIAPS* (1967), p. 49, pl. XII(b) |

| | | | | | | |
|---|---|---|---|---|---|---|
| 1579 | Panhala | Kolhapur | — | ʻAli ʻAdil Shah I | Ahmad ʻAli[5] | *EIAPS* (1971), pp. 74–75, pl. XX(a) |
| 1580 | Galna | Nasik | — | Murtaza Nizam Shah I | Pulad Khan | *EIAPS* (1967), p. 54, pl. XIII(b) |
| 1580–1627 | Mudgal | Raichur | —[6] | Ibrahim ʻAdil Shah II | Dilawar Khan | *EIM* (1935–1936), p. 18, pl. XI(a) |
| 1583 | Galna | Nasik | — | Murtaza Nizam Shah I | Pulad Khan | *EIAPS* (1967), pp. 55–56, pl. XIV(b) |
| 1583 | Bijapur | Bijapur | Haidari Burj | Ibrahim ʻAdil Shah II | — | Nazim, p. 51 |
| 1583 | Vishalgarh | Kolhapur | Daulat Burj | Ibrahim ʻAdil Shah II | Dilawar Khan | *ARIE* (1963–1964), D, p. 211; see also Desai, *Western India*, no. 2149 |
| 1586 | Gulbarga | Gulbarga | Fath Burj | Ibrahim ʻAdil Shah II | Muhammad Haidar | *EIM* (1907–1908), p. 6 [no plate]; see also Desai, *South India*, no. 584 |
| 1588 | Mudgal | Raichur | "Burj-i Fath-i Jang" | Ibrahim ʻAdil Shah II (but begun in reign of ʻAli) | Diyanat Khan | *EIM* (1935–1936), p. 15, IX(a) |
| 1589 | Kandhar | Nanded | "Burj-i Ibrahimi" | ? | Ibrahim Khan | *EIM* (1919–1920), p. 22, pl. XI(a) |
| 1589 | Kandhar | Nanded | "Shahi Burj" | ? | Ibrahim Khan | *EIM* (1919–1920), p. 23, pl. XI(b) |
| 1590 | Bankapur | Dharwar | "Burj-i Khan-i Najafi" | Ibrahim ʻAdil Shah II | Najafi Khan | *EIAPS* (1968), p. 46, pl. VI(b) |
| 1591 | Raichur | Raichur | "Burj-i ʻAli bin Abi Talib" | Ibrahim ʻAdil Shah II | Khawas Khan | *EIM* (1939–1940), p. 18, pl. VII(b) |
| 1597 | Bankapur | Dharwar | — | Ibrahim ʻAdil Shah II | Khurshid Khan | *EIAPS* (1968), p. 47, pl. VII(a) |

[1] The reading given in *Epigraphia Indo-Moslemica* (1907–1908) is ʻIzzat Khan, but Desai reads it as ʻArab Khan.

[2] Desai cites *Epigraphia Indo-Moslemica* (1907–1908), p. 2, but it does not appear to give any text of a second *burj* foundation by ʻArab Khan.

[3] *Epigraphia Indo-Moslemica* (1907–1908) gives the date as 986 A.H./A.D. 1578–1579, but Desai reads it as 972 Hijri (= 1564–1565).

[4] Desai is uncertain as to whether or not the ʻAdil Shahis held Dharur at this point, since the name of the ruler is evidently not mentioned. However, see Firishta (Briggs, *History of the Rise*, III:8081), who notes that Kamal Kishwar Khan was sent by ʻAli ʻAdil Shah to harrass the Nizam Shahis along the border, and that he took some territory and built a new fort, called Dharur. He remains in control of the fort until Murtaza Nizam Shah comes and takes it back (slaying him in the process). So any bastion he built must have been constructed during a period of Adil Shahi control.

[5] Kadiri notes that this Ahmad ʻAli is said to be the son of Raun ʻAli and to bear the title Shamshir al-Mulk. He goes on to suggest that Raun ʻAli is the Shamshir al-Mulk of the Mudgal and Raichur inscriptions, and that Ahmad ʻAli would have inherited the title from his father. See p. 74.

[6] Although the first hemistitch of line 5 is completely effaced, and accordingly there is no reference to the foundation of a *burj*, the inscription is on a *burj* and the second half of the hemistitch reads "the like of which is not to be found in Iraq or Tabriz". Desai, South India, no. 1241 infers it must have referred to the bastion.

other northern sultanates by playing them against each other. But in his haughty, overbearing behavior toward the sultanates to the north, which included the desecration of mosques,[67] Rama Raya overplayed his hand, ultimately driving the northern sultanates to abandon their mutual rivalries and join in a grand coalition to confront Vijayanagara and its high-handed autocrat. Although no direct evidence proves the point, Rama Raya quite possibly picked up his arrogant posture vis-à-vis the northern sultanates from the example of his own father-in-law, Krishna Raya, following the Battle of Raichur.

The great battle took place in early January 1565, some twelve miles south of the Krishna River. Upon reconnoitering at the town Talikota, located to the north of that river, the combined forces of Bijapur, Ahmadnagar, Bidar, and Golconda marched due west, crossed the river, and engaged the immense army of Rama Raya and his brothers near the town of Banahatti in the present-day Belgaum District. According to the historian Firishta, our best chronicler of the battle, Rama Raya's haughty arrogance did not slacken even when confronted with the formidable coalition arrayed before him. He ordered his commanders to bring him the severed head of Husain Nizam Shah of Ahmadnagar and to capture alive both Golconda's Ibrahim Qutb Shah and Bijapur's 'Ali 'Adil Shah so that they could spend the rest of their days confined in iron cages.

Events, however, went otherwise. At battle's end it was Rama Raya who was taken alive from the battlefield, snatched by the trunk of one of the Ahmadnagar elephants and delivered straightaway to Husain Nizam Shah. Given the several occasions on which the Vijayanagara ruler had recently humiliated the Nizam Shahi sultan,[68] it was altogether fitting that he was brought before Husain, who clearly savored this moment of supreme revenge. The chronicler Rafi' al-Din Shirazi, who was in Bijapur's service at the time, relates that Husain, having first seen to it that his "guest" was comfortably seated before him, politely asked Rama Raya about his health. Saying nothing, the octogenarian merely pointed to his head, indicating that he had reached his destiny. At this point a Nizam Shahi noble who happened to be present,

[67] Briggs, *History of the Rise*, 3:73, 74.

[68] In 1561, Rama Raya had driven Husain from his capital at Ahmadnagar and forced the desperate sultan to sue for peace. Rama Raya agreed to this only if the sultan would meet three humiliating conditions: that he cede Kalyana to Bijapur, then allied with Vijayanagara; that he execute one of his finest generals for having interfered with the siege of Ahmadnagar; and that he personally come to Rama Raya's headquarters and eat *pan* (betel nut) from his hand (Briggs, *History*, 3:147).

incredulous at these mock pleasantries, grew uncontrollably agitated and exclaimed, "Rama Raya's army has just now been crushed by his 'son' 'Ali 'Adil Shah! This accursed, arrogant infidel should not be left here before you. There is no time for delay!"[69] With that outburst, and with Husain's evident approval, the noble severed Rama Raya's head, placed it on the tip of a spear, and proudly displayed it before the allied troops as a sign of victory.

What role did firearms play in this battle? To be sure, Rama Raya brought considerable firepower to the battle. Firishta records that he fielded seventy thousand cavalry and ninety thousand infantry, the latter being mainly matchlockmen and archers, although we do not know in what proportion these were distributed.[70] In his front line he interspersed a thousand cannon with two thousand war elephants. Indeed, the battle was initiated with his firing nearly fifty thousand rockets (*ban*), matchlocks (*tufang*), and cannon (*tup va zarbuzan*) at the allies.[71] But the battle was decided by the allies' far more effective use of firepower. Husain Nizam Shah, who commanded the center of the allies' battle formation, brought up six hundred cannon of different calibers, arranged in three rows and fastened together with strong chains and ropes so as to prevent Rama Raya's cavalry from breaking through the allies' lines.[72] In the first row were placed two hundred heavy cannon (*tup-hayi kalan*), in the second were intermediate cannon (*zarbuzan*), and in the third row were the swivel cannon (*zanburak*)—smaller than the intermediate cannon but larger than matchlocks. All the artillery were under the command of Chalabi Rumi Khan, a Turk who, Firishta notes, had earlier served in Europe with distinction, evidently as an Ottoman officer.[73] Masking the artillery stood several thousand archers who showered arrows on Rama Raya's advancing infantry. When the latter got to within range of the allies' cannon, the archers suddenly fell back while the cannon opened fire. The Vijayanagara infantry initially gave way but charged the guns a second time, and in response Chalabi Rumi Khan ordered the gunners to load their ordnance with copper

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[69] Rafi' al-Din Shirazi, *Tazkirat al-muluk* (composed 1609–1612), pp. 75–76. A printed but unpublished copy is with Carl Ernst. We thank Prof. Ernst for furnishing us with a copy of this text.

[70] Briggs, *History of the Rise*, 3:150. Cf. Firishta, *Tarikh*, 2:128; "Haftad hazar savar va nuh lakh piadeh-yi jangi ki aksar tupchi va tir-andaz budand."

[71] Briggs, *History of the Rise*, 3:78; Firishta, *Tarikh*, 2:40; "Piadagan-i Bijanagar pish-i saf-ha istada . . . qarib panjah hazar ban va tufang va tup va zarbuzan bar daf'a sar midadand."

[72] Briggs, *History of the Rise*, 3:78

[73] Ibid., 3:151; Firishta, *Tarikh*, 2:128.

coins and fire at the enemy from close range, a procedure that instantly killed some five thousand attackers.[74] Although that figure was only a fraction of the total of Vijayanagara's casualties on that day, estimated at one hundred thousand,[75] Firishta notes that it was the repulse of this charge by the allies' cannon that decided the battle's outcome.[76]

Just as the Battle of Raichur had been fought both on an open field and at the fort of Raichur itself, the Battle of Talikota really had two sites. The first was the battlefield near the village of Bannihatti, where Rama Raya's army was routed. This was followed by the allies' march down to the sprawling metropolis of Vijayanagara itself. Here, the wide gap that had opened up between Vijayanagara's defense system and that of its northern rivals proved fatal. Not only had engineers at the great capital failed to mount cannon on their bastions or even on curtain walls, but the city never incorporated any of the defensive features that had become standard in the northern Deccan, such as semicircular bastions, high and thick merlons, wide walkways on ramparts, box machicolations (projecting turrets), broad moats, cavaliers, complex gateways flanked by stout, round towers, or barbicans (built-up extensions in front of outer walls).[77] Vijayanagara's defenses had essentially

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[74] Briggs, *History of the Rise*, 3:151–152. According to Rafi' al-Din Shirazi, small coins were discharged from two huge cannons of Husain Nizam Shah. Shirazi, *Tazkirat al-muluk*, p. 75. One of these was the famous "Malik-i Maidan," an immense bronze cannon that Ustad Muhammad bin Husain Rumi had made for the Nizam Shahi sultan in 1549, and which is now in Bijapur. The other one was likely another massive cast bronze cannon, known as "Karak Bijli," that was also cast by Rumi. Unfortunately, it sank in the Krishna River while being brought back north after the battle. See Balasubramaniam, *Saga*, pp. 24–25.

[75] Briggs, *History of the Rise*, 3:79.

[76] "Chuleby Roomy Khan had provided bags of copper money to load [the cannon] with, should the enemy close; and these proved so destructive, that upwards of five thousand Hindoos were left dead close to the muzzles of the guns, before they retreated. The repulse of this charge seems to have decided the fate of the day . . ." (ibid., 3:152).

[77] See Robert Brubaker,"Cornerstones of Control: The Infrastructure of Imperial Security at Vijayanagara, South India" (PhD diss., Department of Anthropology, University of Michigan, 2004), pp. 106, 451–453. On the failure of Vijayanagara and other South Indian forts to adopt the sort of military modernization that took place in the northern Deccan, see Jean Deloche, "Survival of the Hindu System of Fortification in South India (15th–18th Century)," in his *Studies on Fortification in India* (Pondicherry: École Française d'Extrême-Orient, 2007), pp. 153–186. South Indian capitals such as Penugonda, Chandragiri, Tiruchchirappalli, Tanjavur, Madurai, and Palaiyamkottai adhered to pre-gunpowder systems of defense until the late eighteenth century. A likely reason for this conservative tradition was that, notwithstanding Vijayanagara's destruction in 1565, the *nayakas* (petty rulers) of the south regarded themselves as successors to that kingdom and consequently continued to venerate its metropolitan capital in the condition it had been in prior to 1565. See Phillip B. Wagoner, *Tidings of the King: A Translation and Ethnohistorical Analysis of the* Rayavacakamu (Honolulu: University of Hawai'i Press, 1993).

remained what they were in the days of the Battle of Raichur: stone walls built without mortar and punctuated intermittently by square bastions. When, therefore, the victorious coalition of armies from the northern sultanates marched down to loot the city following Rama Raya's defeat in the pitched battle, the great capital lay helpless before the advancing allies. No attempt was made to repel the onslaught; indeed, given the state of the city's defenses, no viable attempt could have been made to defend it.

## A "Military Revolution" in the Deccan?

Even though changes in cannon design in the mid sixteenth-century Deccan had been inspired by technology borrowed from Ottoman and European sources, the nature of those changes, the architectural innovations they inspired, and their political consequences differed radically from developments in contemporary Europe. This invites an attempt to situate military changes in the sixteenth-century Deccan in relation to the theory of an early modern Military Revolution, so much discussed among European historians. First proposed by Michael Roberts in 1955, the theory found an ardent advocate in Geoffrey Parker, who from the mid 1970s on refined, elaborated, and stoutly defended it.[78] In 1995 Parker characterized early modern Europe's Military Revolution in terms of a series of critical innovations or developments, namely (1) the advent, in the fifteenth century, of large siege cannon capable of destroying the vertical walls of medieval forts, which led in the early sixteenth century to (2) a new design of forts that could resist artillery siege, the so-called *trace italienne* style. This in turn produced protracted sieges of the new forts, the capture of which diminished the utility of cavalries but did require (3) large infantries. Raising such armies, however, required (4) expanded administrative structures and more efficient taxation systems—that is, modern states. Finally, (5) the ability to mount cannon aboard ships, combined with the planting of the new forts in coastal enclaves overseas, enabled Europeans to

[78] Roberts presented his thesis as an inaugural lecture before the Queen's University of Belfast in 1955; it was subsequently published as "The Military Revolution, 1560–1660" in Michael Roberts, *Essays in Swedish History* (Minneapolis: University of Minnesota Press, 1967), pp. 195–225. Geoffrey Parker's principal elaboration of the theory is found in his *The Military Revolution: Military Innovation and the Rise of the West*, 2nd ed. (Cambridge: Cambridge University Press, 1996; repr. 1999 with further revision).

project their power on a global stage, leading ultimately to the "rise of the West."[79]

Such a sweeping formulation naturally provoked considerable academic discussion, and not a little opposition, both on empirical grounds and on conceptual grounds—for example, that the theory was technologically deterministic, chronologically misplaced, or burdened with a marked teleological trajectory.[80] More recently, Parker and Sanjay Subrahmanyam in a joint essay globalized the discussion—and also dodged the theory's teleological trajectory—by considering the different ways that firearms were received by a number of Asian societies in the early modern period. They concluded that local responses to the introduction of firearms in India, China, Japan, and mainland Southeast Asia varied widely, running the gamut "from enthusiastic acceptance accompanied by innovation to more-or-less outright rejection: a bald contrast between dynamic and forward-looking European military systems and static non-European ones will not work."[81] Our study of the early modern Deccan would support that position. Indeed, respecting the question of a unidirectional flow of military technology from Europe overseas, implicit in conventional understandings of the Military Revolution,[82] we have seen that as early as 1513 some technology moved in precisely the opposite direction, from Muslim gunsmiths in Goa formerly employed by the Bijapur state to Lisbon.

In other respects, too, the early modern Deccani experience with military technology veered sharply from the contemporary European pattern. Consider fort design. Sixteenth-century Europeans and Deccanis responded very differently to the threat of siege cannons capable of battering down stone walls. In Europe, as the advent of such can-

[79] Geoffrey Parker, "In Defense of the Military Revolution," in Clifford J. Rogers, ed., *The Military Revolution Debate: Readings on the Military Transformation of Early Modern Europe* (Boulder, Colo.: Westview, 1995), p. 338.

[80] Such arguments are most trenchantly advanced by Jeremy Black. See his *Beyond the Military Revolution: War in the Seventeenth-Century World* (New York: Palgrave Macmillan, 2011).

[81] Geoffrey Parker and Sanjay Subrahmanyam, "Arms and the Asian: Revisiting European Firearms and Their Place in Early Modern Asia," *Revista de Cultura* (Macau) 26 (2008): 32. Indeed, their analysis suggests that in Japan during the 1560s and 1570s two features of Europe's Military Revolution—the construction of geometrically designed forts to provide flanking fire, and the rotational firing of musket volleys—evolved independently of European influence, and that the latter actually appeared in Japan twenty years before it did in Europe (ibid., pp. 30–32).

[82] This view is most explicit in David B. Ralston, *Importing the European Army: The Introduction of European Military Techniques and Institutions into the Extra-European World, 1600–1914* (Chicago: University of Chicago Press, 1990).

non tipped the balance in favor of the attackers, defenders of cities or forts sought to neutralize that advantage by radically reconfiguring the defense of strongholds and urban centers. Using the *trace italienne* design, walls were lowered and thickened to give incoming projectiles less target to hit, wide ditches were added to keep siege guns at a greater distance, and angled bastions were added to cover blind spots along the walls. The last feature gave the new forts their characteristic arrow-shaped bastions and overall star-shaped pattern.[83] By building slanting, low-profile walls that denied prominent targets to besieging cannon, the *trace italienne* system adopted an essentially defensive posture, the general idea being not so much to eliminate the besiegers as to minimize the destructive force of their attack, a strategy that led to protracted siege campaigns and wars that could last for many years.[84]

Such a strategy seems also to have inhibited significant change between the sixteenth and nineteenth centuries in how defensive cannons were deployed in Euro-American forts. The practice of mounting guns on wheeled wooden carriages and placing them behind curtain walls with their muzzles poking through gun ports is seen in strongholds built as late as Fort Ticonderoga (1755) in upstate New York, or even Fort Sumter (1860) in coastal South Carolina. Such forts reveal essentially the same mode of deploying defensive cannon as that used by Henry VIII in strongholds built along the English Channel in 1539, some two or three centuries earlier.[85] Such a response hardly suggests "revolution," but rather something closer to stagnation.

But in the Deccan, as Jean Deloche has noted, the architectural response to the advent of siege cannon took a path very different from that in Europe, or anywhere else.[86] It was not as though Deccani engineers were unaware of the Europeans' new style of fortification. As early as 1535 the Portuguese built a fortress in the classic *trace italienne* style at Bassein, a seaport some seventy kilometers north of modern

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[83] Parker, *Military Revolution*, pp. 6–24. See also Simon Pepper and Nicholas Adams, *Firearms and Fortifications: Military Architecture and Siege Warfare in Sixteenth-Century Siena* (Chicago: University of Chicago Press, 1986); Christopher Duffy, *Siege Warfare: The Fortress in the Early Modern World, 1494–1660* (London: Routledge and Kegan Paul, 1979); and Christopher Duffy, *Fire and Stone: The Science of Fortress Warfare, 1660–1860* (London: Greenhill Books, 1996).

[84] Parker, *Military Revolution*, p. 43.

[85] For Henry VIII's fortress, see the manuscript illustration reproduced in ibid., p. 27.

[86] See Jean Deloche, "Gunpowder Artillery and Military Architecture in South India (15–18th century)," *Indian Journal of History of Science* 40, no. 4 (2005), 373–377; Jean Deloche, *Studies on Fortification in India* (Pondicherry: École Français d'Extrême-Orient, 2007), pp. 141–142.

Mumbai, and in 1612 they built another such stronghold at Aguada, just west of Old Goa on the coast of the Arabian Sea. Deccani engineers simply chose to pioneer a very different strategy. Instead of building low with a view to denying besieging cannon a prominent target, engineers in Bijapur and in neighboring sultanates built bastions with even higher profiles than those they had replaced, complete with cavaliers and gun platforms on which huge cannons could be mounted and rotated both vertically and up to a full 360 degrees of range laterally. The height of these bastions is stressed over and over again in their foundation inscriptions, as in the one recorded at Galna by the governor Aflatun Khan. He notes that he constructed a bastion "the like of which had not been seen by the eyes of the world. It was higher than the heavenly sphere."[87] By building up such commanding heights and mounting huge swivel guns on them, the idea was not so much to protect the fort from enemy fire as it was to prevent besiegers from approaching close enough to fire effectively at all. Planting big guns on high platforms necessarily increased the range of those guns, permitting a fort's defenders to target an attacking force before it could threaten a fort's defensive perimeter. In short, we find here a strategy of defending a fort by taking the offensive, as opposed to the more purely defensive posture of Europe's *trace italienne*. Essentially, whereas Europeans radically altered their fort design without significantly changing how they mounted their cannons, Deccanis first built larger and more maneuverable cannons and then adapted their fort design to accommodate them.

Indeed, patrons of the Deccani system seem to have grasped the military significance of both the big swivel guns they introduced and the newly designed bastions on which those guns rested. This is seen in the foundational inscriptions, recorded in Persian, found on the new guns and, especially, the remodeled bastions. In the sixteenth-century Deccan, such inscriptions were normally reserved for recording only what patrons regarded as the most important of public acts—for example, the construction of mosques, gateways, irrigation tanks, public wells, tombs of prominent personages, or the promulgation of tax codes. What is more, many of these guns and bastions were given personal names, suggesting a nearly affective relationship between patron and object—for example, the cannons Fath-i Lashkar ("Victory of the Army") and Top-i Illahi ("the Divine Gun") at Bidar, or the bastions

[87] *Epigraphia Indica—Arabic and Persian Supplement* (1967), p. 45, plate XI(b).

Fath Burj ("Victory Bastion") and Shah Burj ("King's Bastion") at Raichur. No pre-sixteenth-century bastions were honored with foundational inscriptions, much less personal names.

What were the political consequences of these military innovations? Significantly, the period of intensive bastion rebuilding in the northern Deccan correlates with an overall stabilization of frontiers between the leading sultanates of the Deccan plateau: Ahmadnagar, Bijapur, Golconda, and Bidar. By conferring a defensive advantage on holders of forts and by making it increasingly difficult for an attacker to carry out a successful siege, the new advances in military technology seem to have frozen interstate political boundaries where they had existed during the 1560s. Figure 9 shows that, whereas some forts changed hands several times prior to 1560, this pattern ceased from the late 1560s on. This was true even in one of the plateau's most volatile zones, such as the long arc running west to east through the forts of Parenda, Sholapur, Naldrug, Kalyana, and Bidar. Along this arc, Sholapur, Naldrug, and Kalyana had been seized by neighboring sovereigns as many as three times each in the sixteenth century. The most intense period of interstate conflict occurred in the single decade from 1549 to 1559, when Parenda, Naldrug, and Kalyana all changed hands twice, and Sholapur once. But from the 1560s, by which time these forts had begun building the new, high-profile bastions and gun mounts, sieges, if attempted at all, were no longer successful.[88]

Moreover, as the northern Deccan's borders stabilized, states exhibited more distinctive identities than at any time since they had emerged as successors to the Bahmani kingdom in the early sixteenth century. We see this in coinage. Although the issuance of coins stamped with its own dynastic name signaled a Muslim state's legal independence, for the first seven or eight decades of their independent existence the Deccan's four principal sultanates chose not to issue such coins, preferring instead to use existing stocks of Bahmani coinage. But then, rather abruptly, between 1578 and 1584—just as the northern Deccan's internal borders were stabilizing—all of the region's sultanates began issuing their own coins as common currency.[89] The sharp mid

[88] The only fort to have changed hands after the building boom had begun was Sholapur, but that was not seized militarily; rather, it was transferred as a dowry gift from Husain Nizam Shah to 'Ali 'Adil Shah when 'Ali married Husain's daughter in the early 1560s.

[89] The first was 'Ali 'Adil Shah I (r. 1558–1589), who issued silver "larin" coins from the port of Dabul in 1578. He also issued two varieties of copper coins, one with *tughra* characters on both sides and the other with ordinary but crude lettering. In Ahmadnagar, the first coins minted by the Nizam Shahi sultans appeared in 1581. Although the

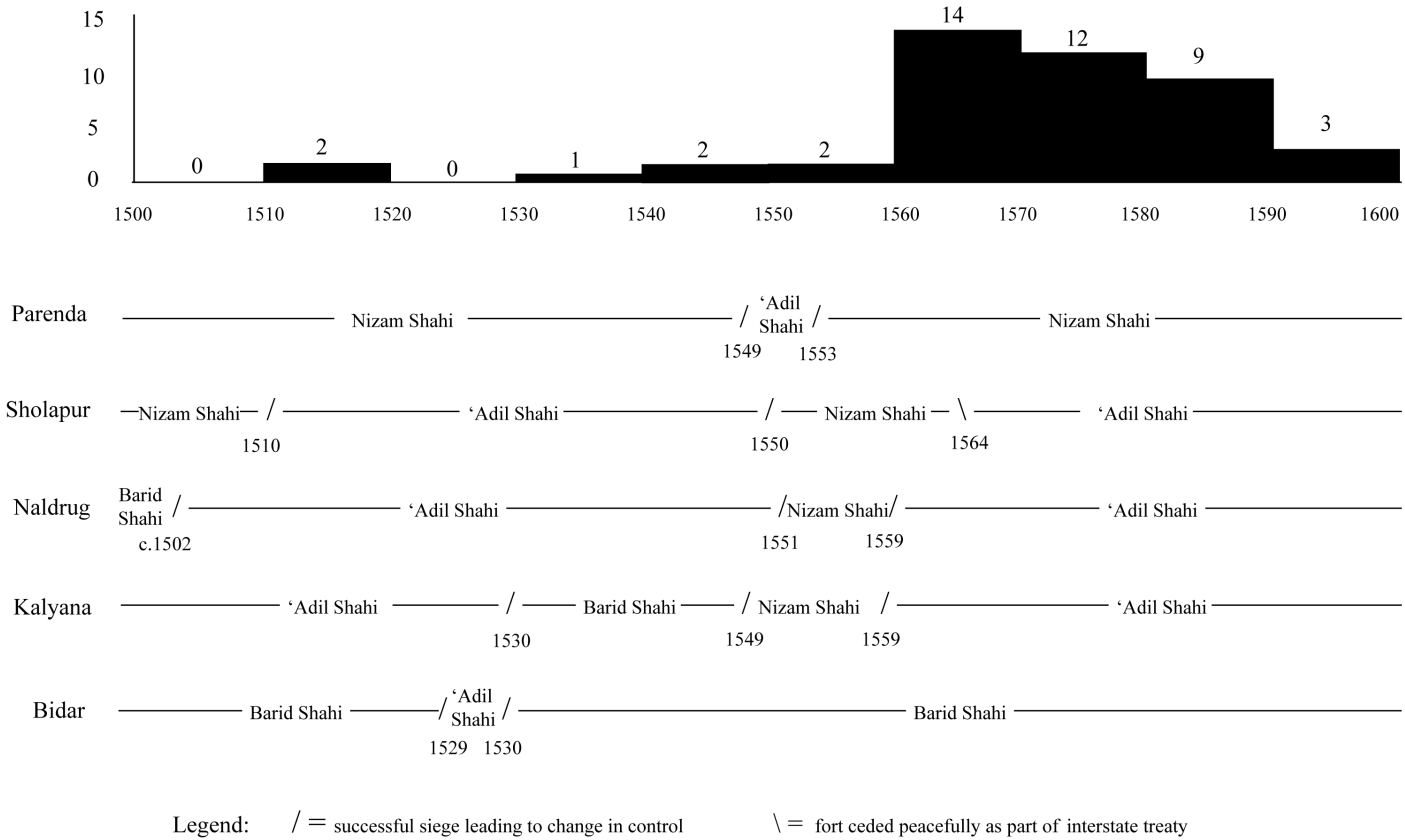


FIGURE 9. Number of documented bastions built in the Deccan by decade, and changing control of forts in northern contested zone, 1500–1600.

century reduction of interstate violence and the stabilization of frontiers with which it is associated also correlate with the surge of cultural production that characterized the Deccan in the later sixteenth and early seventeenth centuries. For it was in the post-1560 period that Ahmadnagar's Murtaza Nizam Shah I (r. 1565–1588), Bijapur's Ibrahim 'Adil Shah II (r. 1580–1618), and Golconda's Muhammad Quli Qutb Shah (r. 1580–1612) emerged as famously generous patrons of architecture, music, art, and literature, and it was in this period that we witness the emergence of unique styles in art and architecture at these three kingdoms.[90]

## Summary

Deccanis had been acquainted with gunpowder and firearms from at least the 1460s, and by the end of the first decade of the sixteenth century the 'Adil Shahi rulers of Bijapur had attained an advanced level of cannon and matchlock manufacture at their arsenal in Goa. Shortly after capturing that city in 1510, the Portuguese viceroy, Afonso Albuquerque, acknowledged that the firearms he found in Goa's arsenal were superior to anything then being made in Europe. But up to this point, and through the Battle of Raichur ten years later, Bijapur's rulers had merely added firearms to their military repertoire. Nothing like a "military revolution" in the Deccan can be said to have occurred by that time.

But by midcentury, firearms were playing an increasingly important role both on battlefields and in sieges. Now they could determine

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Qutb Shahi sultans of Golconda minted a few coins rather early, these appear to have been curiosities and did not circulate as coinage. It was not until the reign of Muhammad Quli Qutb Shah (r. 1580–1611), whose first coins appeared in 1580 or 1581, that their coins achieved widespread circulation as currency. Similarly, the Barid Shahi sultans of Bidar did not start issuing their own coinage until the reign of Ibrahim Barid Shah (1580–1587). See Dilip Rajgor, *Standard Catalogue of Sultanate Coins of India* (Bombay: Amrapali Publications, 1990), p. 625; Stan Goron and J. P. Goenka, *The Coins of the Indian Sultanates* (New Delhi: Munshiram Manoharlal, 2001), pp. 315, 321, 326, 336. One might argue that such an affirmation of a kingdom's independent identity arose in defensive reaction to growing Mughal pressures on Deccan states. But Mughal expansion in the Deccan did not begin until the 1590s or, at the earliest, the late 1580s with the succession struggle that followed the death of Ahmadnagar's Sultan Murtaza Nizam Shah. See Muzaffar Alam and Sanjay Subrahmanyam, "The Deccan Frontier and Mughal Expansion, ca. 1600: Contemporary Perspectives," *Journal of the Economic and Social History of the Orient* 47, no. 3 (2004): 357–389.

[90] See George Michell and Mark Zebrowski, *Architecture and Art of the Deccan Sultanates*, The New Cambridge History of India I, 7 (Cambridge: Cambridge University Press, 1999), pp. 115–225.

the outcome of pitched battles, as happened in 1565 at the Battle of Talikota. Siege cannons also played a decisive role in seizing forts, especially those that had formerly been under Vijayanagara's authority and had *not* been modernized. Just several years after the Battle of Talikota, for example, a Qutb Shahi army besieged the eastern stronghold of Rajahmundry, then held by chieftains formerly loyal to the recently annihilated Rama Raya. The fort quickly fell after a four-month barrage by cannon fire had opened a breach fifty paces wide in the citadel's walls.[91] In 1579 a similar fate befell another eastern stronghold, Kondavidu, then held by a nephew of Rama Raya. Having failed to take the fort by storm, a Qutb Shahi army dragged its siege cannon up the hills to within a moderate distance of the walls and battered down one face of the citadel, facilitating the fort's capitulation.[92]

Does all this add up to a "military revolution" in the Deccan? If this notion is understood in terms of a single chain of cause-and-effect changes, as formulated by Parker in 1995, the Deccan certainly did not experience such a thing. If, however, one were to speak of "military adaptation," following Jeremy Black's suggestion, then the Deccani experience becomes more readily comprehensible.[93] We need to consider why and how Deccanis adapted new technologies to fit their particular circumstances. One factor was the frequent military conflicts among the various states of the plateau, which would have motivated participants to develop more efficient means of prosecuting war. Using the frequency with which forts changed hands as an index of a region's relative stability, Map 2 reveals two principal military frontier zones in the sixteenth-century Deccan: Bijapur's northern border with Ahmadnagar (Parenda, Sholapur, Naldurg, Kalyana, Bidar) and that state's southern border with Vijayanagara (Raichur, Mudgal, Torgal). Tellingly, forts along these two frontier zones were among the first to be modernized with renovated bastions and cannon-mounting systems, suggesting a correlation between the intensity of conflict and the likelihood of modernization.

Furthermore, the Deccan's unique topography, with its many hilltops spiking up from an otherwise flat plateau, seems to have pushed technological experimentation and adaptation in a certain direction. For centuries prior to the advent of gunpowder, Deccanis had taken

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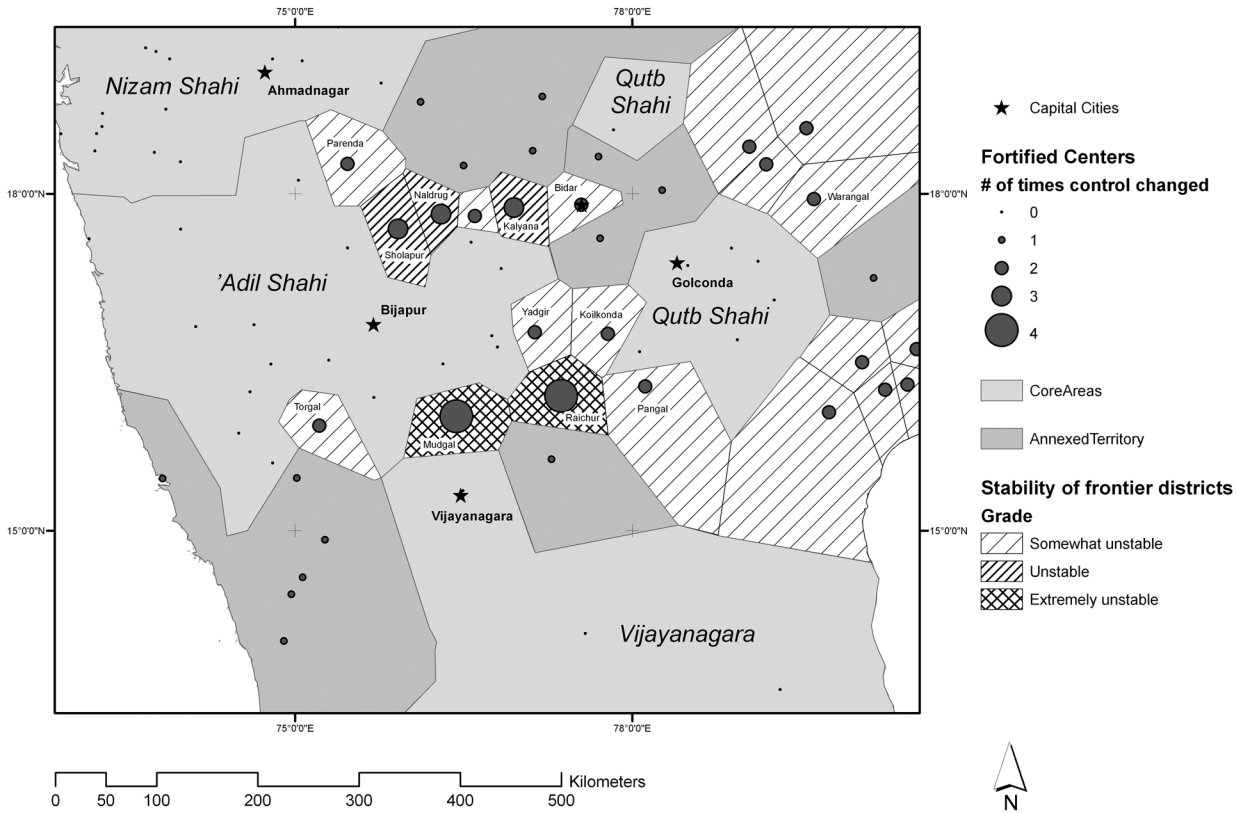
[91] "Anonymous History of the Qutb Shahis," in Briggs, *Rise*, p. 253.

[92] Ibid., p. 263.

[93] Jeremy Black, *Beyond the Military Revolution: War in the Seventeenth-Century World* (New York: Palgrave Macmillan, 2011), p. 5.




Map 2. Unstable frontier zones in the Deccan, sixteenth century.

advantage of the plateau's naturally hilly terrain by building forts on its many promontories. Being easier to defend than plains forts, hill forts enabled chieftains to control surrounding countrysides and their rural populations by using both the stick of coercion—that is, a fort's garrisoned cavalry—and the carrot of holding (or withholding) grain stored in their granaries. In this way, power itself was conceived in terms of the ability to use prominent heights in order to dominate people below. When firearms reached the Deccan, new gunpowder technologies were simply adapted to serve that same conception. This was accomplished by building upward, placing larger cannon on higher positions, and mounting them on swivels so as to control more ground below. After all, it was on hill forts—namely Yadgir, followed by Kalyana, Naldrug, and Kandhar—that Bijapuri authorities from the 1550s on first experimented with mounting large cannon on bastions and cavaliers.

Although interstate warfare and a hilly topography were found throughout the Deccan plateau, it is notable that extensive technological experimentation occurred only in the plateau's northern sector among the successor states to the Bahmani kingdom, and not in the southern kingdom of Vijayanagara. Here the Battle of Raichur (1520) and, more precisely, the opposing responses to that battle's outcome appear to have been critical in triggering the chain of important technological innovations that occurred in one part of the plateau but not in the other. In Vijayanagara, victory at Raichur without a significant use of firearms had lulled its leaders into a state of complacency, with the result that their military system stagnated until their own catastrophic defeat and political collapse in 1565. In Bijapur, by contrast, crushing defeats both at Raichur fort and on a nearby battlefield stimulated the kingdom's rulers to overcome their earlier faulty use of firearms by embarking on a crash program of experimentation and adaptation.

To the visitor who surveys the many hill forts that dot the Deccan plateau today, two features stand out most prominently: their imposing bastions bearing enormous guns, and their large granary facilities. Each feature symbolizes a very different sort of power. The former projects a stark image of brute force, whereas the latter more subtly signals a commander's ability either to feed or to withhold. Today these vast, empty granaries contain only cavernous dead space. Yet the sight of such structures lying so close to fearsome engines of destruction reminds one that if the technologies pioneered by Deccani engineers introduced tactical innovations in the ways of war, strategically, they ended up accommodating entrenched conceptions of power and social relations.